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TELEGRAPHIC COMMUNICATION WITH THE EAST IN WAR TIME.

Now that we seem to be on the verge of a war in which security from interruption in our communication with India and the East generally is a matter of vital importance, much consideration is being given to the best method for securing a continuous telegraphic service. We hope that this will prove no fitful fancy, to be either shelved or brought to light as the state of diplomatic negotiations with Russia, and other powers, takes a favourable or an unfavourable turn. That the necessary line will have to be maintained is beyond all dispute; and this will have to be managed under great difficulties, for as the Earl of Carnarvon pointed out in the House of Lords last week, the Russian Government, in 1878, had "a carefully elaborated scheme for taking measures against our submarine cables in Eastern waters." Of one thing we may be quite certain, viz., that the Russian Government is now at least quite as well prepared to damage these cables, should necessity arise, as it was seven years ago; and in places, the comparative shallowness of the water in which the cables lie would not throw much difficulty in the way of such operations. Besides this, a point of much importance was raised in the discussion above referred to, by the Marquis of Salisbury, relating to the difficulties which might arise in the case of lines passing through neutral territory, especially if the nation concerned were not "benevolently inclined." The lines to the East having a common landing place in Egypt, are there liable to be subjected simultaneously to some interfering influence, which probable political complications may give rise to in that country, possibly at the most critical moment. Should such an event as that which we hint at take place—and we may well take such a possibility into account in discussing this matter—not only should we be cut off from India, China, and Australia; but our means of communicating with the Cape of Good Hope would be destroyed; and as in war time, owing to the neutralisation of the Suez Canal, all transport of men and material to India might have to resume its old route *viâ* the Cape, this would be a most serious loss.

The cable which it is the intention of the English Government to lay down the West Coast of Africa from St. Vincent will be most useful, as affording an alternative route not so liable to inimical interruption as the existing lines, for it will only touch on the territory of an undoubtedly friendly Power. This cable might be prolonged to India, either by modifying the present route of the East Coast of Africa cable, or preferably by a direct line *viâ* Mauritius. Thus the depth of water would be in itself a most effectual protection: for in deep water we know that even when furnished with every information and appliance it is not always an easy matter to find and pick up a cable. From the Cape towards Mauritius, bad bottom might be expected, indeed, most probably would be found, for the *Pall Mall Gazette* gives it on Sir James Anderson's authority that to maintain communication intact on one section alone of the East Coast of Africa cable requires no less than five repairing ships. However, by keeping away well to the East of Madagascar the necessity of such careful nursing might be avoided. There is no doubt that the remedy which we point out would be a costly one, but it would at least free us from the risk which we are at present running by carrying all our eggs in one basket, and would be an absolute necessity in the case of the canal being closed to Government vessels.

In the China sea it is unfortunate that a long length of cable might have to be laid to replace the present sections which touch French territory in Saigon, more especially as a cable would on account of the shallowness of these waters run more than the usual risk of being destroyed. However, the subject as a whole deserves most serious consideration and should not be looked on as only a commercial matter, for the security of our communication with the East is a matter of the greatest moment and one in which the question of cost plays by comparison a minor part.

CABLES TO THE CAPE.

For some time past there has been discussion respecting cable communication with Cape Colony, the frequent interruptions of the existing cable laid from Aden along the eastern coast of Africa to Natal on the one hand, causing loud complaints and imperious calls for a more efficient service, and the growing importance of several places at present having no telegraphic communication with Europe on the other, pointing to the necessity of some new arrangement. Merchants and others interested in various ways in South Africa gave vent to their dissatisfaction last Friday at Baron Grant's meeting at Cannon Street Hotel; and none can say they have not had grave cause for their murmurings. The speeches made by Baron Grant, Captain Mills, Mr. Silverbauer and others, clearly demonstrated the great inconvenience sustained, not only by the trading community, but by the Government, in consequence of the prolonged severance of the line. The general view of those assembled seemed to be in favour of a cable on the western side of the continent; but no well-considered scheme was submitted. Perhaps it was scarcely the province of the meeting to discuss the details of any scheme; rather was it its duty to record simply a protest against the state of things to which the public has had to submit since the cable was laid to Cape Colony. Baron Grant suggested a route—from the Cape to the island of St. Helena, thence to

Cape Coast Castle, on to Sierra Leone, and joining the Brazilian line at the Cape de Verde Islands. This line would have the advantage of touching British territory only, and would be of great value to the Government in time of war. But it is not probable that it would ever become commercially successful.

Sir James Anderson states that the whole of the traffic on the East coast may be transmitted in three hours each day. This, by the way, seems to indicate that there is but little business done from any of the intermediate points at which the cable calls; and it is also clear that the Cape alone could not supply sufficient traffic to make a direct cable to St. Helena and Cape Coast Castle remunerative. In the face of the opinion expressed by Captain Mills it is useless to hope that the Cape Government would subsidise this line, if it were constructed. From the Home Government alone could any help in this form be expected, and it is just possible that it might, seeing how valuable St. Helena and Ascension Island would become as coaling stations with telegraphic communication established (the cable in that case being extended so as to touch at the latter island), assist an enterprise of this description pecuniarily. Looking at the matter from a commercial point of view *solely*, perhaps the best scheme would be to run a cable along the Western Coast, calling at such places as Angra Pequena, Walfisch Bay, Benguela, the Congo, the Cameroons, Lagos, Cape Coast Castle, Freetown, Bathurst, and so on, or such of these places as might be thought proper. All down the Western Coast are settlements belonging to various European nations, all becoming rapidly more and more important, and having a by no means inconsiderable trade with Europe even now. A line such as we suggest would be of immense importance to the countries interested—England, France, Germany, Portugal and Belgium—and it is not at all unreasonable to suppose that more than one of these would be prepared to grant subsidies for the maintenance of such a useful line. But, of course, the question of greatest importance is how best to serve Imperial interests by having direct communication which could not easily be severed by an antagonistic power. The English Post Office has already intimated its willingness to subsidise a line from Cape St. Vincent to some point in the Bight of Benin, and we may suppose has schemes which have been submitted to it under consideration at the present moment. The Silvertown Company has laid a cable as far as St. Louis, Senegal, the idea being entertained of eventually extending it down the Western coast. Whether this project is carried out or not, we are convinced of the desirability of a Western route, and entertain no doubt that it will within a measurable period of time be established.

Telegraph Revenue.—The receipts in the telegraph service from April 1st to April 18th, 1885, amounted to £65,000, an equal sum having been received up to the 19th April last year.

THEORETICAL AND EXPERIMENTAL RESEARCHES ON THE SECONDARY GENERATORS OF GAULARD AND GIBBS.

By PROFESSOR GALILEO FERRARIS.

(*Continued from page* 346.)

SEC. 7.—*Description of the New Experiments made by Means of the Calorimeter.*

I made my experiments from the 11th to the 16th of November, 1884, in the locality of the Turin Exhibition with the apparatus there exhibited by the National Society for the Distribution of Electricity by Secondary Generators, of London, and as I have said above, I had as my principal object to check the results previously obtained with the electrometer and the electro-dynamometer, by means of which I have established, by a new method, that these apparatus cannot be adopted as instruments of measurement. In accordance with the desire of my colleagues on the International Jury, I studied to make use, as the only instrument of measurement, of a calorimeter, against which no objections can be raised.

Not being able to exclude completely the use of the electrometer and of the electro-dynamometer, I arranged the matter in such a manner that these instruments should not serve directly for measurement, but I employed them solely as a means of recognising the constancy of a mean difference of potentials and of the mean value of the strength of a current.

The principal peculiarity of the new method is, that it does not require the use of any other instrument than the calorimeter, and if we make abstraction of the modifications which the employment of the new instrument of measurement must inevitably introduce into the conduct of the experiments, the method is reduced in principle to one of those of which we have spoken before.

In substance it is the following: the mean of the squares of the intensity of the secondary current is measured by means of a calorimeter, the mean is multiplied by the measured resistance of the secondary circuit, and thence the quantity of energy evolved in a unit of time in the said secondary circuit. The Gaulard apparatus is then removed from the circuit, for which there is substituted a resistance deprived of self-induction the value of which is made to vary in order that there may be at its extremities with a mean current strength a mean difference of potential equal to that which first existed at the extremity of the primary spiral. The mean of the squares of the strength of the primary current was then determined by a calorimetric measurement made with the same calorimeter employed before. This mean multiplied by the resistance measured gives the value of the energy transformed into heat. The resistance inserted in the primary circuit is what in our theory has been called r, and hence the quantity of energy calculated in the above manner is what we call Q. Dividing by this the measured energy of the circuit we have m; dividing the rise of temperature of the calorimeter in the first experiment by that obtained in the second, we have the ratio of the mean squares of the intensity of the two currents; and as we have also the resistance, r', of the secondary and r_1 substituted in the primary we have all the magnitudes which figure in our equations; enough for a complete study of the apparatus.

When I undertook my experiments I had not intended developing the theoretical considerations which have been expounded in this investigation. Hence my plan aimed essentially at the determination of m. Nevertheless it will be seen that experiments can effectively supply all the data which may be required, and I think that the improvements, which are several and important, which others may be able to introduce consist in the details of the instruments and not in the principle.

A radically different procedure can be had only by having recourse to a direct dynamometrical mea-

surement of the work absorbed in the secondary generator. But such a measurement cannot be always executed with the desired exactness and cannot, for instance, be obtained in the case of my experiments where the dynamo machine supplying the secondary generators was powerful enough to absorb 60 horse-power and received its movement from a steam engine of above 140 horse-power.

Description of the experiments.

The calorimetric apparatus consisted essentially of a spiral of silver wire of the diameter of 0·4 millimetres and 2·40 metres in length wound on a disc of ebonite covered with a coating of shellac and immersed in the water of a closed calorimeter of silvered copper of the diameter of about 12 centimetres and 20 centimetres high. The calorimeter is protected in the usual manner by a cylindrical receiver of brass, closed, and protected in turn by a case of wood. The thermometer, which fits in a central aperture existing in the disc of ebonite, is secured by a tubulated cork placed in the centre of the lid. It is graduated in tenths of a degree and is observed by means of a telescope, which enables the fifth of a division, or the fiftieth of a degree to be read off with certainty. Two apertures left in the cover and fitted with small tubes of hard caoutchouc give free passage to two copper wires of 1·1 millimetre in diameter, attached below to the ends of the spiral and having above terminals for the introduction of the circuits. By means of these wires the current can be passed into the spiral. A cross-piece of ebonite connects externally the two wires and is attached to a small cord passing over a pulley by which a regular ascending movement of about three centimetres can be given to the spiral. It serves for renewing the water in contact with the wire and rendering the temperature of the calorimeter uniform.

By using, as I have done, such a calorimeter, as well for the measurement of the secondary circuit as for that of the primary, the difficulty of absolute measurement is avoided. We avoid even the need of determining the constancy of the calorimeter and the resistance of the spiral.

The constancy of the mean strength of the primary current is obtained by means of the regulator of the exciting current of the dynamo machine and is determined by means of a Siemens electro-dynamometer inserted in the circuit. The constancy of the mean difference of the potentials at the two terminals of the primary spiral of the commutator or at the extremity of the resistance which in the second part of the experiment is substituted for the apparatus, is obtained by causing this resistance to vary and is determined by means of a Mascart electrometer used according to Joubert's method. When the difference of potential is greater than that for which the electrometer is adapted the two points are united, by which we may ascertain the constancy of the mean difference of potential with a derived circuit of the greatest resistance made with incandescence lamps connected in series and attached to the wires of the electrometer at two convenient points of the circuit. As it is not required to *measure*, but simply to *ascertain* the constancy of the potential, it is not important to know the resistance of the lamps nor to verify their equality. It is merely necessary that the resistance should be very great to the end that the derivation may not sensibly disturb the phenomena which take place in the secondary generator. In my experiments I ordinarily made use of 12 Edison lamps of which there were attached to the wires of the electrometer a number which was made to vary from experiment to experiment so as to have in the electrometer a deviation comprised within the limits of the scale, but always very great.

The arrangement for the experiments is represented in fig. 2.

The two leads coming from the dynamo enter the laboratory at A and Z. A comes to a commutator with two contacts, B, Y, by means of which without breaking the circuit (which in a Siemens alternating current machine of more than 3,000 volts might occasion grave inconveniences) the current may be sent at pleasure by the contact, B, to the measuring apparatus, or may be passed along the wire, Y, X, directly to Z, excluding thus the circuit from entering the laboratory.

From the contact, B, the current passes along the wire, M, to a Siemens electro-dynamometer, S; from this it passes to a second commutator, C, *a*, *b*, which lets it pass to the secondary generator, G, when contact is established with *a*, but turns it into the variable resistance, *r*, and the calorimeter, Q, when the contact is established at *b*.

The secondary generator is represented by G; *p*, *q* represent the two terminals of the primary spiral, and *s*, *t* represent the terminals of the secondary spiral. The end, *p*, of the primary spiral communicates by means of a wire with the contact, *a*, of the commutator, C, *a*, *b*, already mentioned; the other end, *q*, communicates with two wires, D and H, the first of

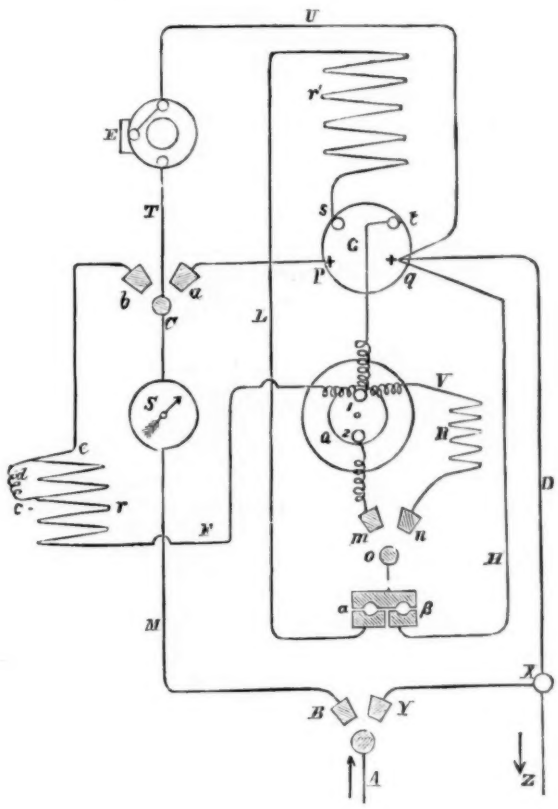


FIG. 2.

which joins Z, and the other communicates with a double plug commutator, *α*, *β*, of which below. The secondary spiral has one of its extremities, *s*, in connection with a resistance, *r'*, without self-induction, the value of which may be made to vary at will from one experiment to another and by means of the wire, L, with the commutator, *α*, *β*, just mentioned. The other extremity, *t*, communicates with the extremity, 1, of one of the wires of the calorimeter.

The calorimeter is represented in Q, where the little circles, 1 and 2, represent the terminal ends of the copper wires which come from below to join the two extremities of the nickel-silver wire immersed in the water. To one of these, 1, are attached the wire, F, which comes from the variable resistance, *r*; the wire, *t*, 1, which comes from the secondary spiral of the secondary generator, G, and a third wire, V, which leads to a resistance, R.

The other end, 2, of the calorimeter and the other extremity of the resistance, R, are joined to two contacts, *m*, *n*, of a slide-commutator, *o*, *m*, *n*, by means of which, without interrupting the circuit, the current

may be passed through the calorimeter or through the resistance, R. The resistance, V, R, is free from self-induction and is equal to that of the calorimeter. The equality, obtained with great care before beginning the experiments, is verified from time to time during their progress.

The commutator, α, β, is destined to introduce the calorimeter at pleasure into the secondary or the primary circuit.

When the plug is at a the secondary circuit, s, r', L, α, O, 1, t, is closed, the calorimeter or the resistance, R, being inserted; when, on the other hand, the plug is at β the secondary circuit is interrupted, but the primary current may be passed through the calorimeter, or through R along the course A, B, M, S, C, b, r, F, 1, O, β, H, q, D, Z. The tongue must be at β whenever the commutator, C, a, b, makes contact at b, otherwise the primary circuit would be interrupted, and, as with a dynamo machine such as I used at the Exhibition, impelled by a motor of great power, a rupture of the primary circuit would be able to occasion grave inconveniences and dangers; before working the commutators, C, a, b, and α, β, I always placed the commutator, A, B, Y, at the contact, Y, thus excluding the entire laboratory from the circuit.

The Mascart quadrant electrometer is represented at E. It was connected to the points, C and q. For greater clearness it is supposed in the figure that the connection is made directly with two single wires, T, U; but in reality, and for the reasons given above, the two points, C and q, were, in my experiments, joined to each other by means of a conductor of very great resistance formed by a series of 12 Edison lamps of 16 candle-power, connected in series, the wire, T, was attached at C, and the wire, U, was attached to a point of the same conductor taken behind a number of lamps which was made to vary from experiment to experiment according to need.

When the communication at C and a was established with the commutator, C, a, b, the electrometer indicated the mean fall of potential from the two ends, p and q, of the primary spiral of Gaulard's apparatus; when in turn the communication of C and b was established with the commutator, C, a, b, the electrometer showed the fall of potential the end, b and q, of the conductor b, r, F, 1, O, β, H, q, which comprises the calorimeter, or the equal resistance, R, and besides the resistance, r, which could be varied at pleasure, so as to obtain with the electrometer a deviation equal to that due to the secondary generator.

(*To be continued.*)

THE VALVE TELEPHONE TRANSMITTER.

THIS transmitter, which is the joint invention of Professor Sylvanus P. Thompson and Mr. P. Jolin, is of that class in which the air waves act directly upon the current regulator, without the employment of any tympanum or diaphragm. In the apparatus the sound waves formed by the voice are directed by means of a mouthpiece, and caused to pass upwards through an orifice and impinge upon a valve. This valve rests freely over or upon the orifice, and its weight is supported by a valve-seat. The action of the sound waves upon the valve produces variations in an electrical current in a manner which will be understood from the following figs.:—

Figs. 1 and 2 illustrate a simple form of the valve telephone. a is the valve, which consists of a ball (preferably hollow) of some conducting material, supported upon the valve-seat, b, which is a ring also of some conducting material, over the orifice of the tubular cavity, d, in the block, B, the sound waves being directed upwards through the tube, d. If the weight of the valve be insufficient to secure the requisite contact between valve and seat, the valve may be furnished with a stalk or tail-piece, e, and a small weight at the end thereof. A light and flexible wire, c, is connected to the valve, so that the valve forms one electrode; the seat forming the other electrode. The sound waves will tend to lift the valve from its seat and let it down again, thereby varying the electric current, as in an ordinary microphone.

The spherical form of the valve shown possesses the advantages of being self-adjusting upon its seat and requiring no guidance.

As above described, the valve forms (or is part of) one electrode, and the seat forms the other electrode; the inventors prefer, however, to divide the seat into two or more parts or segments insulated from one another, as shown by figs. 3, 4 and 5. In these cases, instead of using the valve as an electrode they use one part or parts of the seat as one electrode, and the other part or parts of the seat as the other electrode; the valve in this case completing the circuit between the two electrodes. (Fig. 3 also illustrates a convenient mode of fitting up the valve telephone.)

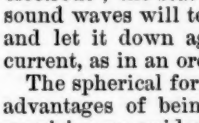


FIG. 1.

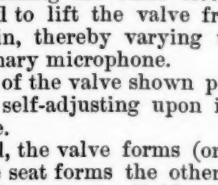


FIG. 3.

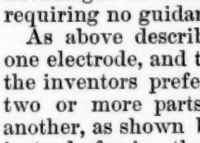


FIG. 2.

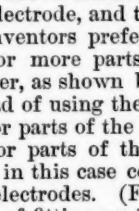


FIG. 4.

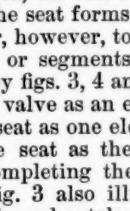


FIG. 5.

It is well known that when two rigid bodies are in contact, three points of contact determine their approximation one to another, whilst if it be attempted to produce a contact in four points an element of instability is introduced. For instance, a three-legged table always stands firm, even on an unlevel floor, whilst a rigid four-legged table will not stand firm, if the floor be level, unless the extremities of the legs are all in one plane, or on an unlevel floor, unless the fourth leg be of such length as to reach the ground at

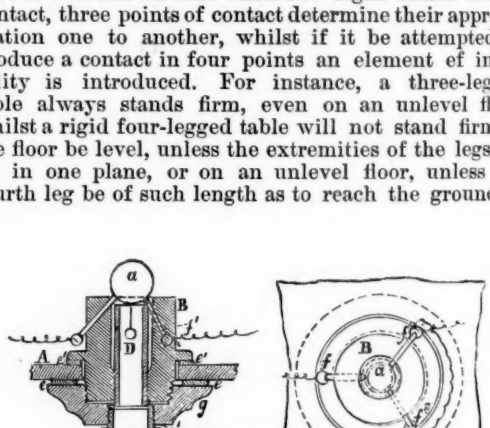


FIG. 7.

FIG. 6.

the point where it should stand. Applying this principle to the valve telephones, the inventors find it to be very advantageous to seat the valve upon three pins of suitable conducting material, as shown in elevation by fig. 6, and in plan by fig. 7. By this means, the element of uncertainty in the action of the telephone, due to the variation of the contact points of valve and seat, which is introduced if the surfaces are not fitted with mathematical accuracy, is eliminated. The pins should project above the orifice of the tube, so that the valve may be slightly raised above such orifice, leaving a

narrow space between the valve and the edges of the orifice about the width of the thickness of a sheet of paper. This form of valve-seat may be applied with advantage to valves of other than a spherical shape. The pins may be adjustable, if desired, and may be made of metal tipped with gold, platinum, iridium, or other infusible metal or conducting material.

The conducting material used for the contact pieces may be such as is available for similar purposes in ordinary microphones or telephone transmitters; as, for example, any non-metallic substance, such as coke, which is a sufficiently good conductor, and which is capable of being made up into the desired form of valve. The inventors, however, state that a metal or metalloid or alloy answers the purpose as well as, and, in some cases, better than any non-metallic body; and, in particular, they have found that phosphor bronze, silicium bronze, selenium bronze, tellurium bronze, and sulphur bronze give good results.

It will be observed that the inventors arrange the valve relatively to the direction of motion of the sound waves, so that the increment of pressure due to the sound waves tends to lift or remove the valve from its seat, although the lifting of the valve should only take place to an infinitesimal extent. With this arrangement, the valve being free to move, as a whole, away from its seat, the motion or tendency of motion of the valve is simply one of translation, without deformation or change of shape, whence result the advantages in the utilisation of the energy of the sound waves hereinbefore pointed out. The seat should be of such a form and so placed that it may not to any appreciable extent enter into vibration under the influence of the sound waves, so that the whole available energy of the sound waves may be as far as possible concentrated upon the valve alone.

For practical purposes the inventors find that the form of the instrument shown by figs. 6 and 7 gives the best results in practice. In this instrument, the valve and valve-seat are carried by a cylindrical block, B, of wood. The block, B, passes, without touching, through a circular aperture formed in the bottom of the box or case, A. The block, B, is supported and maintained in its position by two annular pieces or rings, e and e^1, of India rubber or other equivalent dampening material, which encircle the said block and prevent vibrations of the box or case from affecting the working parts. D is a tube of brass or other suitable material, which is situated within a cylindrical cavity extending axially through the block, B. The tube, D, fits closely the lower part of the said cavity, but there is an annular air space between the tube, D, and the upper portion of the inner surface of the block, B. The tube, D, is of such length that its upper end is somewhat below the upper end of the block, B, which encircles it.

The valve, a, is seated upon three pins, f, f^1, f^2, inserted in the upper portion of the block, B. These pins should touch the sphere or ball, a, at three points, which preferably are equidistant, in a horizontal plane cutting the said sphere at a point below its centre. These pins are preferably tipped with gold, platinum, iridium, or other non-fusible metal or conducting material. The pins, f^1, f^2, are connected together to form one electrode, and the third pin forms the other electrode.

Upon the lower end of the block is screwed or otherwise secured an annular cap or rose, g, provided with a central opening, g^1, into which is inserted the end of a speaking tube, h, provided with a suitable mouthpiece, h^1. The tube, h, may be either rigid or flexible.

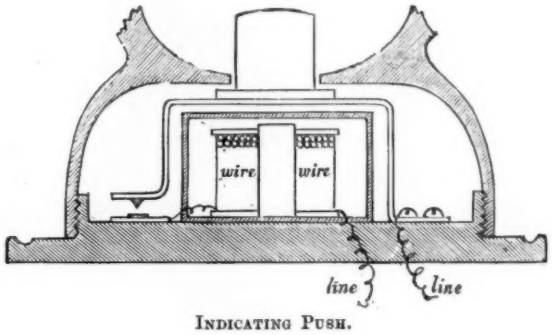
MACKENZIE'S PATENT ELECTRIC BELL INDICATOR.

One of the complaints against electric bells is that no means exist of knowing whether the bell has rung when the push button has been pressed. Several attempts have been made to overcome this supposed defect, but, until now, none of sufficient simplicity and cheapness to warrant their general introduction.

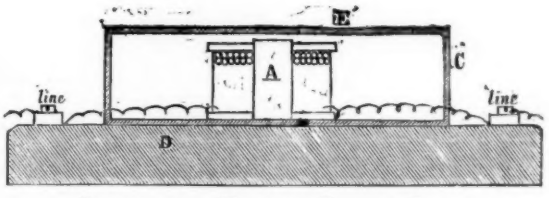
The Mackenzie indicators introduced by Messrs. Woodhouse and Rawson are said to fulfil every requirement, being also very cheaply made and having no working parts to get out of order.

Its mode of action can be readily seen from the annexed sketch. A is a soft iron core fixed to an iron base, D, and surrounded by a bobbin of wire which forms part of the circuit upon which the appliance has to be used. An iron box, C, is placed over this electromagnet, having the lid, E, close to the end of the core. Upon the current traversing the bobbin, the core, A, and the lid, E, become magnetised with opposite polarities and emit the sound; the make-and-break action of the bell, however, immediately comes into play and the core and the lid losing their magnetism again emit a sound which continues to be given out as long as the current is passing.

This is the well known "Page effect" made use of practically. The action being solely molecular no moving parts are needed, and, therefore, there is nothing to get out of repair; and, being an audible instead of a visual indicator, its use is not restricted to any place



Indicating Push.



Indicator for Fixing to Existing Push.

where light is required, as its sound is capable of being increased to any desired amount. The apparatus can be adapted to any place where electric bells are used, and can also be made to take the place of a bell itself if required; being exceedingly small it can be fitted inside the push itself, the whole forming one complete instrument, or, if preferred, it can be made separately and adapted to existing arrangements.

It is obvious that such an instrument can be applied to numerous other purposes than those set forth above.

Admitting that considerable ingenuity is shown in designing such apparatus as here described, we cannot help expressing our doubts as to their usefulness. They must add to the cost of construction of the bell-push, and we do not see how they increase the value of an electric bell system. In an hotel, for example, as at present fitted up, should a visitor press in the button and no attention be paid to the summons, he usually concludes that the bell rings but that the servants are not at the moment at hand. An indicator to assure him of the fact would not help in such a case, and it would be no consolation to a visitor to know from a non-emission of sounds in the indicator that the bell circuit was broken or short circuited. Again, people must necessarily be informed when engaging rooms as to the object of the apparatus, and this would be felt by many to be objectionable.

JOEL'S ENGINE-DYNAMO AND MOTOR.

IN most of the dynamo machines hitherto made the mechanical construction of the whole machine, and of the armature in particular, has been very defective and inconvenient. Should an armature become deranged, say through a short circuit in one of the coils, or from the ring slipping on the hub, it was generally impossible to repair it without returning the whole machine, or at least the armature, to the maker, thus involving delay, and, for a time, rendering the electric lights useless, and bringing the whole system into partial discredit. It was to remedy this defective mechanical construction that Mr. Henry F. Joel, C.E., designed his engine-dynamo machine.

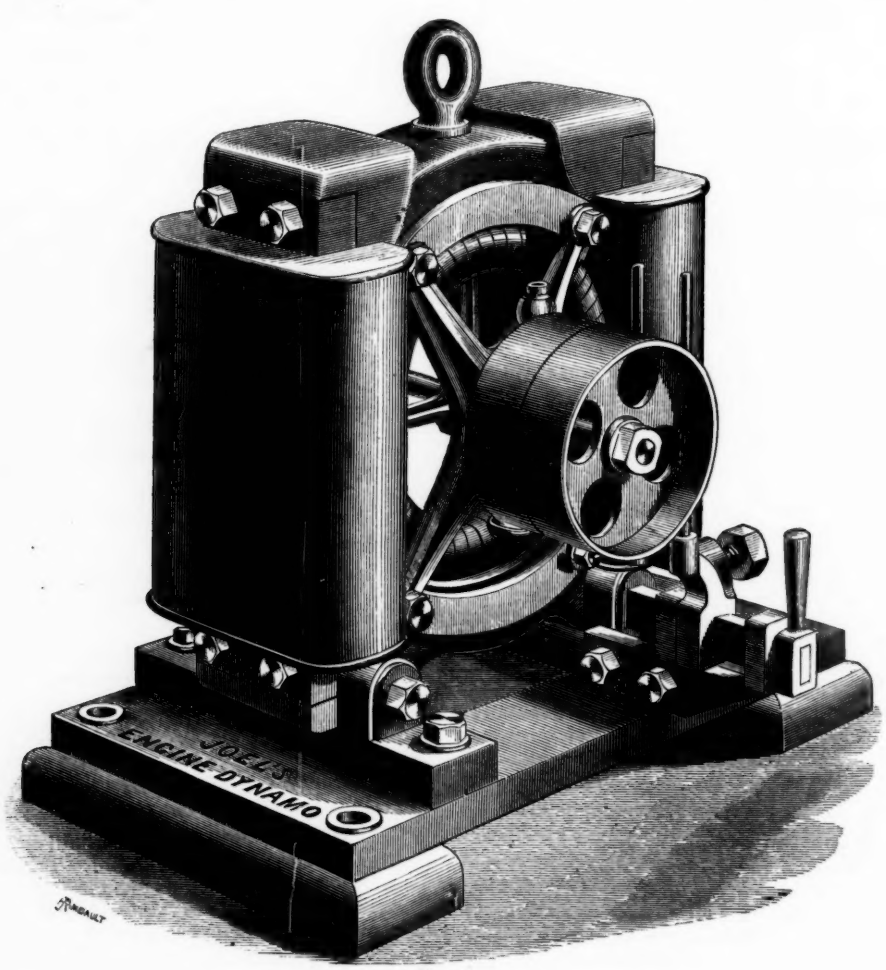


FIG. 1,

WITH ADJUSTABLE BED PLATE AND SCREW-TIGHTENING GEAR, FAST AND LOOSE PULLEYS AND STRIKING GEAR.

During the last six years Mr. Joel has made many experimental magnets and dynamo machines, and he claims to have introduced many improvements, the result being the dynamo machine we are now describing.

Its general construction is readily seen from the illustration, fig. 1. There are two vertical field magnets with very massive cores made of wrought iron, carefully chosen and annealed. These are bridged across at the top and bottom by heavy iron poles, moulded in selected cast-iron. This form is considered to give the best magnetic field. It is urged that it is a great point in this machine that there is plenty of iron of good quality in its construction, and the iron is so disposed that there is very little waste weight. The under faces of the poles have slots, or grooves, cast in them to break up eddy currents, and to accumulate the magnetic effect as much as possible at the centre of the poles.

The coils are wound on a bobbin or sleeve, and can be easily taken off.

Fig. 2 shows the complete armature, which is of the Paccinotti type. It is built up of sections or groups of laminated iron plates of segmental shape, which are punched or stamped with the tooth shaped projection, alternately at one end, out of the best Swedish iron (see fig. 3). These thin plates are insulated from each other, except at the junctions of the sections, where iron is pressed in contact with iron to form a series of continuous rings. The complete sections interlock and fit each other, and are fastened by bolts (also insulated) to the end of spokes, made of non-magnetic material, and thus form the rim of a wheel armature ; with this construction the armature cannot slip or get out of place ; it is rigidly fixed, not merely clamped as in some machines. The bolts are fitted parallel to the axle to prevent their loosening by centrifugal action. The insulated wire coils (see fig. 4) are separately wound on a lathe or otherwise (this is a special feature of the invention), an l are then threaded on the core sections ; should a coil become damaged the core section is taken out, and the coil slipped off, and a new one quickly put in its place.

The commutator is fixed close to the armature, and the ends of the coils are connected in a special and convenient manner to the commutator, and in order to facilitate the removal of any of the coils on the armature, they can be quickly and well connected or disconnected without soldering.

The brushes are supported on an adjustable frame,

which is fitted on the end of the axle ; the unscrewing of one milled hand-nut allows the brushes and holder to be taken off, and the same nut clamps the brushes in any position. The movement allowed in the brush holder will enable, say, a 12-light arc machine to run only one or all the 12 lamps, or any intermediate number as desired ; special provision is made for holding the brushes off the commutator by an automatic locking device ; this is very useful when working with gas engines.

The axle is made of steel and is very short, the bearings are three to four times as long as the diameter of the axle, the bearing frame on the pulley side is made especially strong, and braces the top and bottom poles, and the whole machine, rigidly together. The pulley bearing on the commutator side is of bracket form, and designed to allow the connections of the armature and the commutator and brushes to be easily got at for cleaning, and also to give the utmost possible play to the brush holder. Special arrangements are made for lubricating the bearings and collecting the waste oil.

The engine-dynamo is so named from its perfected mechanical construction, by machinery, in detachable

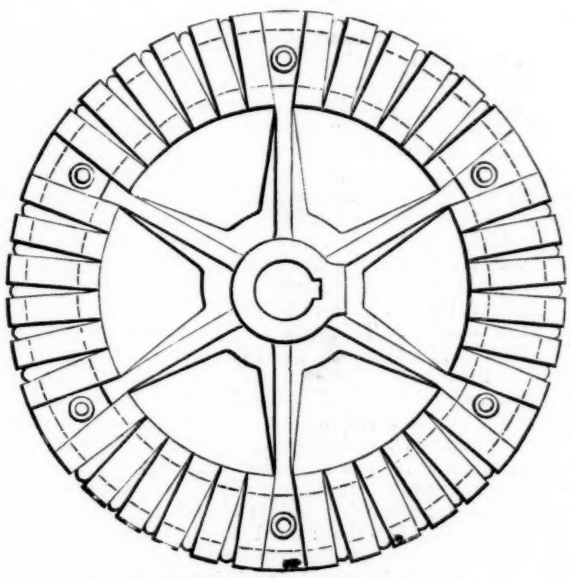


Fig. 2.—Diagram of Built Up Armature.

pieces. Each part of the dynamo can be quickly and easily taken apart, and in case of necessity be repaired by the purchaser or user without returning the machine to the makers ; this is useful on board ship and other places where an easily repaired machine is a desideratum. The armature sections and coils, the field-magnets and every part are made to steel templates and gauges ; they are interchangeable and can be replaced, and the engine-dynamo is specially constructed to act either as a generator of electricity or as an engine motor for driving machinery. The arrangement of the fast and loose pulleys, and striking gear, see fig. 1, is very compact and strong. The adjustable base is also shown, and is very simple and easily attended to.

The advantages claimed by the inventor are :—

The whole machine is built up of detachable parts, which are interchangeable.

The armature, which in other dynamo machines is usually the weakest part, and exceedingly difficult to repair, is in the "engine-dynamo" very simple and strong, and easily taken to pieces and put together again.

The armature coils are separately wound to an exact size, and the insulation is more perfect.

The peculiar construction of the armature core obviates the loss due to Foucault currents, and allows free ventilation.

The coils on both the field magnets and armature can be changed as desired, and with the same iron frame many changes in the electrical output can be obtained.

The brushes, commutator, oil feeds, and other parts are strong, and convenient in construction.

The machine is said to take up less room, and to be stronger built, than any other dynamo. Many tests of these machines have been made. A very interesting test was made by completely insulating the iron sections the one from the other by thin mica plates, to ascertain if the jointed construction affected the out-put ; but after careful trial the tests showed that the insulation and disjointing made no difference in the results.

A machine of this type, made and tested in 1882, showed a marked improvement over a Schuckert machine of a slightly larger size and heavier weight. In this case the total weight of the machine was 2 cwt. 1 qr. 4 lbs., with 58 lbs. of copper wire on the armature and field ; this gave at 1,200 revs. per minute an effective current of 130 volts and 8 ampères. In a recent machine, made by Messrs. Blakey and Emmott, electrical engineers, Halifax, Yorkshire, who are manufacturing these machines under license from the inventor,

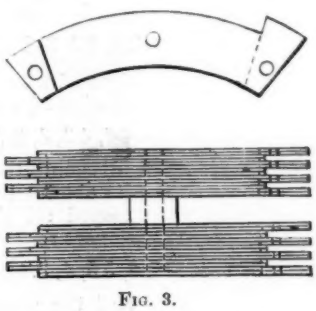


Fig. 3.

Elevation and Plan of Detachable Core Section.

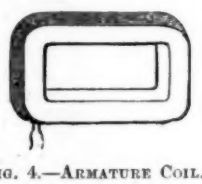


Fig. 4.—Armature Coil.

(Separately wound and detachable.)

the results were much better as with only 6 lbs. of copper on the armature, and 30 lbs. of copper on the fields, an out-put of 1,000 watts was obtained at a moderate speed ; at 1,500 revolutions per minute, the usual speed for such a small machine, this output would be much increased ; still better results have been obtained by a slight modification of the resistances and at a speed of about 1,200, three arc lamps can be worked from a machine whose bulk is contained in about two cubic feet and whose total weight is only about 2 cwt. From recent tests which have been made, we are given to understand that the commercial efficiency of the machines has been found to be nearly 80 per cent., whilst the conversion is considerably over 90 per cent. Messrs. Blakey and Emmott have put down special tools and plant in their large works for the manufacture of these dynamo machines, in various sizes and for all purposes, from a one arc lighter to a 500 incandescent lighter, and wound in series, shunt or compound. These machines will be in practical use at the Inventions Exhibition, one being driven from Messrs. Hathorn and Davey's domestic motor.

The Telephone and Colonial Defences.—A dispatch from Victoria, Vancouver's Island, states that all the batteries are being connected by telephone.

MAGNETIC INDUCTION.

THE following experiments, writes Mr. Wm. B. Cooper in the New York *Electrical Review*, show that the law of attraction of horse-shoe magnets departs from that of *inversely as the square of the distance*, in proportion as the armatures *fail to evoke the maximum force of the magnet.*

A permanent horse-shoe magnet was used, composed of two magnets bound together, each bar being about $\frac{9}{32}$ in. thick, $1\frac{1}{4}$ in. wide, and 10 in. from poles to *U*. The distance between the poles being about $\frac{7}{16}$ inch. They weigh together 73 ounces, and lift about 24 lbs.

Slips of cardboard, about $\frac{1}{60}$ in. thick, were used for separating the armature from the poles.

The first number in each of the following scales represents the portative force, in ounces, with one slip intervening; and the numbers following are the results of successive additions of slips.

First experiment, with armature $\frac{1}{16}$ in. wide, $\frac{1}{4}$ in. thick, $2\frac{3}{16}$ in. long, at back, and $2\frac{1}{16}$ in. at face; which evokes nearly the maximum force. Weighing about three ounces, and placed edgewise:

101·5, 47·5, 29·5, 19·5, 16, 13·5, 12, 10, 9, 8·5, 8.

Second experiment, with armature, $1\frac{1}{16} \times 3\frac{5}{8} \times \frac{1}{45}$ in.; weighing about $\frac{1}{2}$ oz., edgewise also:

13, 9, 6, 4·5, 4, 3·8, 3·5, 3·3, 3, 2·7, 2·5.

Third experiment, with a piece of wire $2\frac{1}{16}$ in. long, and $\frac{5}{32}$ in. diameter; weighing about $\frac{1}{4}$ oz.:

13, 10·3, 7·8, 7, 5·7, 5, 4·7, 4·3, 4, 3·7, 3, 4.

The magnets were then disconnected from each other, and the following results obtained by using the 3 oz. armature; which developed all the attraction available at the respective distances:

37·5, 17, 11, 8, 5·5, 4, 3.

At this point—the weight of the armature having been reached—the experiment was discontinued, for want of a suitable balance; but it is sufficient to show that the law of *squares* does not apply to horse-shoe magnets.

These experiments were made somewhat hastily by the writer, with such appliances as were at hand, in order to obtain for himself data for which he had sought in vain through all the literature upon the subject.

The results obtained suggested the possibility of increasing the efficiency of dynamos and motors by using a greatly increased relative strength of field; and indicate the rule to be followed wherever it is desired to obtain the maximum work from a given weight of armature.

CONSULTING ENGINEERS' RACTICE.

WE (*American Engineer*) have recently heard an interesting account from a friend, a consulting engineer, whose speciality is advising capitalists, as to the investment of money in engineering schemes and mechanical appliances. Among his clients and those who seek his advice are men who have retired from regular business, former dry-goods merchants and the like, who have little knowledge of machinery, its value, and method of manufacture. As a striking example, he tells of a gentleman who had acquired an interest in a compound-locomotive invention, his interest being obtained for a small sum of money and for the cost of prosecuting the patent. While the patent was being applied for by a regular attorney, he came to see the consulting engineer and requested a report as to the merits of the invention. This was obtained in due time to the effect that the invention was valueless as an engineering device, had no commercial value, and that probably even the meagre combination-patent claimed would not be granted. A reasonable fee was charged for this report and a cheque promptly received. Six months later this same gentleman called on the consulting engineer and reported that no patent had been obtained, and that his past experience had taught him a lesson never again to invest money in an invention before having it carefully examined by unbiassed engineering authority. After this satisfactory and encouraging preliminary, he informed the consulting engineer that he would like him to look into the merits of a certain invention, but added that he desired to spend no money in case the invention was no good. In other words, he desired to spend no fee for the engineer's time and brain work, if the result of the investigation proved the invention to be without value. The engineer promptly replied that since at least nineteen out of every twenty inventions were valueless, he could shut his doors if he were to do business on this principle. It was known to the engineer at the time that the gentleman in question had retired from the dry-goods business at the beginning of the year with a capital of 200,000 dollars.

The above is fact not fiction. It seems strange that a good business man, such as the capitalist had undoubtedly shown himself to have been in his dry-goods ventures, did not realise that such a procedure at least brought up the temptation to report favourably, irrespective of conscience. The consulting engineer, a man of undoubted integrity, pointed out this fact, and the capitalist receded from the small, narrow view which he had previously entertained.

This seeking of "free advice" from consulting engineers is one of the chief annoyances of the business, though, of course, there are others; such, for instance, as where the (former dry-goods) capitalist wants to be sure that one size machine shall have a certain out-put, which requires some leeway in construction, but is very fretful lest this be exceeded by the least percentage, so that if a customer wants a machine only a trifle larger, he will have to take the next size of five times the capacity. This may be admirable dry-goods practice, but it is scarcely good engineering; or, again, bids for the construction of a machine are issued, all to competent and responsible parties, and the lowest bidder does not get the award because the capitalist, who understands nothing of tools and appliances, is not impressed by the facilities, although the consulting engineer pronounces them adequate. There is really a moral issue in this problem of award of contract, which should signify the award to the lowest responsible bidder who guarantees conformity with the drawings and specifications, and is willing to meet the forfeits which non-compliance stipulates.

REPORTS ON ELECTRIC LIGHTING.

(*Continued from page 357.*)

"THE distribution of light on the surface differs of course very materially with the mode in which light is reflected or refracted. Three-fourths of the light emitted by a naked lamp are absolutely wasted as far as the street is concerned; it is lost in the sky. When the intensity of the light is too great for the eyes to bear with comfort, the barbarous practice is in vogue of destroying 50 per cent. of the remaining fourth, by covering the light with an opaque, or semi-transparent shade. The uniform distribution of light over the surface of a street means the utilisation of those rays that are now wasted upwards in the air, and their diffusion without unnecessary loss by absorption. Very rough and unscientific modes of doing this have been attempted by the gas and electric light companies, but with very little success. The light is still distributed in bright patches, which are separated by dark intervals. Gas light must necessarily be enclosed in a lantern which, while it supplies air for combustion, checks draughts and currents which lead to imperfect combustion. The question has been most ably and scientifically attacked by Mr. A. P. Trotter, who has produced a dioptric lantern that merits the most careful consideration and examination. Mr. Trotter has applied to street lamps the same principles that are so effective in our lighthouses in converging all the rays upon a horizontal plane. He makes clear flint glass globes or lanterns, of such patterns and shapes that the rays of light are diverted and reflected, as shown in the following diagram:—

"Diagram 2 shows the influence of this dioptric lantern in spreading the light. The black curve shows the natural diffusion of the unobstructed rays of light; the dotted curve shows the effect of opal globes, or opaque shades; the straight horizontal line shows the effect of the distributing system by means of the dioptric system. The areas embraced by these curves indicate the comparative economy of the different modes. It is seen how wasteful is the obstructive or shaded system.

"The eye is affected directly by the intensity or quality of the light. It does not take in the quantity of light emitted. The height of the vertical line in these curves gives the intensity at any point, and it indicates how the eye is affected at those points. Thus it shows that, while the dioptric prism apparently lowers the intensity, it spreads the quantity over an enlarged area. Hence it is that when the eye alone estimates the value of the dioptric lantern it is deceived, and it is only scientific measurement by photometers that enables a true conception to be formed of the efficiency of the system.

"The economical distribution of light is largely effected, as I have shown, by its diffusion, but the practical problem as regards our streets is determined more by the amount and degree of light emitted by each lamp, by its height above the ground, and by its position along the street. The illumination of any point is the resultant, or combined effect of all the neighbouring lamps whose rays fall on that point. It is very easy to calculate this resultant when the number of lamps is few, and still simpler to show the result by diagram. Diagram No. 1 shows this distribution when the lights are fixed at various distances apart, and arranged quincuncially, that is, like the five of diamonds, or any other suit of cards.

"When the distance apart is twice the height of the lamp, there is a variation of 30 per cent., and at three times the height, 60 per cent., but with the dioptric lantern the distribution is practically uniform.

"The following table is calculated to show the theoretical distribution of light from different sources:—

	Arc lamps, 20-feet post.		Glow lamps, 12-feet post.	
Candle-power (nominal).....	1,000	500	20	50
Horse-power	1	0·75	0·1	0·25
Area illuminated in acres ...	0·353	0·353	0·1	0·1
Horse-power per acre	2·83	2·12	1	2·5
Length of street, feet.....	172	172	60	60
Horse-power per 100 feet ...	0·58	0·435	0·167	0·41
Maximum illumination in luces	2·5	1·25	0·139	0·348
Minimum do.	0·055	0·0275	0·011	0·0275
Mean do.	0·41	0·205	0·023	0·0575

"As a matter of fact, the mean actual illumination of the arc lamp, owing to obstruction and absorption, is only about one-fourth of the calculated, and the mean actual illumination of the glow lamp by reflection and refraction is twice that calculated. Hence the mean illumination of the 50 candle-power glow lamp and that of the arc may be about the same.

3.—The Measurement of Electricity.

"No proper conception of the economical production of the electric light can be arrived at without careful and accurate measurements of the quantities of electricity used. Electricity may be wasted in an unknown and unseen manner, unless a careful watch is kept on its performance. It was therefore essential that an accurate measurement of the electrical pressure and of the strength of the electric currents used should be determined.

"The practical instrument used to measure the electrical pressure is called the *Voltmeter;* that to measure the current the *Ampèremeter;* that to measure the energy consumed the *Wattmeter.* Absolutely reliable instruments of these kinds have not yet been produced, so that where accuracy is essential, laboratory experiments must be made. There are many kinds of instruments in the market, too many, in fact. Every engineer seems ambitious to devise a new form. This is perhaps one proof of their want of reliability. Of voltmeters I have used:—Sir William Thomson's, Cunynghame's, Cardew's. Of ampèremeters:—Siemens's, Thomson's, Aryton and Perry's, Cunynghame's, Uppenborn's.

"Of wattmeters I have used none, for I have obtained sufficiently accurate results by multiplying together the volts and amperes. Some of these instruments, though equally practical and useful, required frequent verification and calibration in the laboratory.

"As an example of the mode of taking electrical measurements, I give the following results:—

"Wimbledon, 20*th May*, 1884.

"Three 50-candle Woodhouse and Rawson lamps in one group:—

Observation.	Electromotive force in volts.	Current in ampères.	Watts per lamp.
1	52	7·5	130
2	52	7·5	130
3	56	6·9	128·8
4	56	6·9	128·8
5	48·5	7·8	126
Mean per lamp	52·9	2·4	128·7

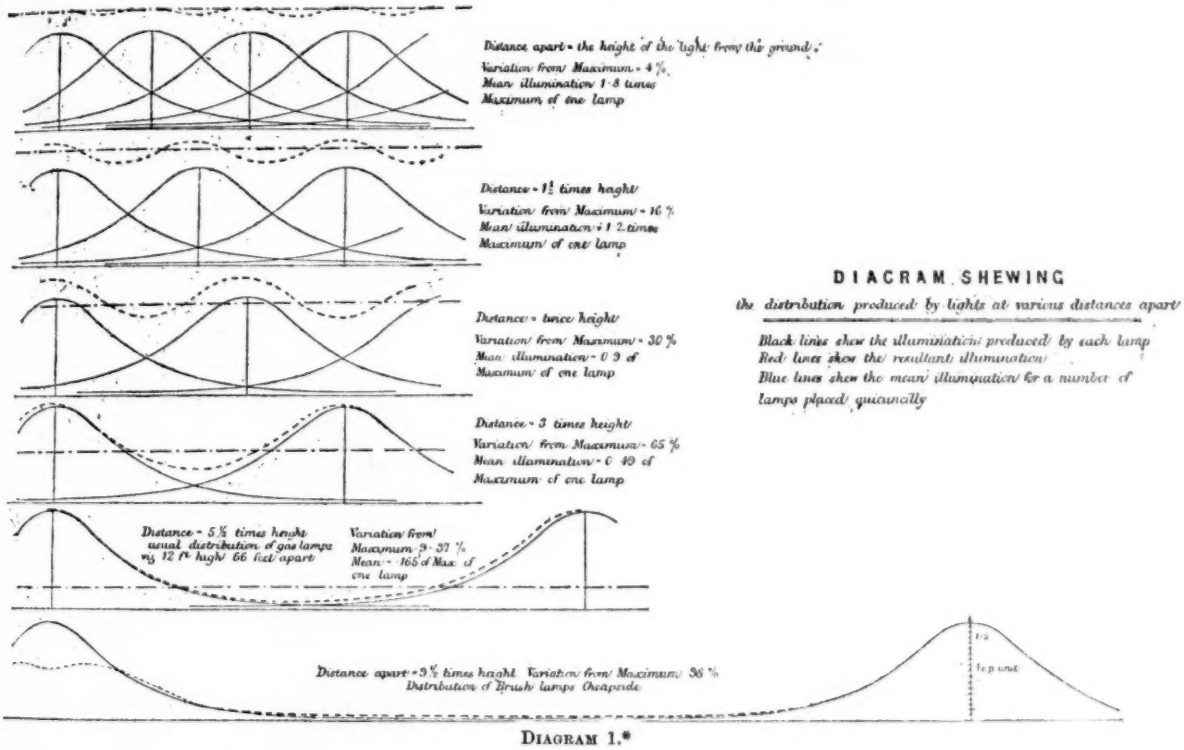

Distance apart = the height of the light from the ground.
Variation from Maximum = 4 %.
Mean illumination 1·8 times
Maximum of one lamp
Distance = 1½ times height
Variation from Maximum = 16 %
Mean illumination = 1·2 times
Maximum of one lamp
Distance = twice height
Variation from Maximum = 30 %
Mean illumination = 0·9 of
Maximum of one lamp
Distance = 3 times height
Variation from Maximum = 65 %
Mean illumination = 0·49 of
Maximum of one lamp
Distance = 5¾ times height
usual distribution of gas lamps
say 12 ft high 66 feet apart
Variation from
Maximum 9·37 %
Mean = 165 of Max. of
one lamp
Distance apart = 9¾ times height. Variation from Maximum 36 %
Distribution of Brush lamps Cheapside
DIAGRAM SHEWING
the distribution produced by lights at various distances apart
Black lines show the illumination produced by each lamp
Red lines show the resultant illumination
Blue lines show the mean illumination for a number of
lamps placed quincunxially

Diagram 1.*

* Black, red, and blue lines are represented in the curves by full, dotted, and dot and dash lines respectively.—Eds. Elec. Rev.

4.—THE DISTRIBUTION OF ELECTRICITY.

"By this term is meant the arrangement of generators, conductors, and lamps, so as to obtain steady light with the least expenditure of energy, the smallest weight of copper, and the most economical form of lamp.

"The crux of electric lighting consists in its mode of distribution. The Electric Lighting Act of 1882 contemplates three modes of distribution, viz., the *Series*, the *Parallel*, and the *Charging* systems.

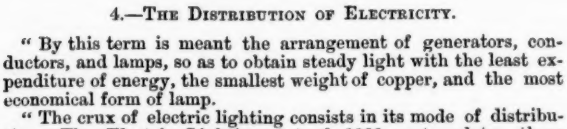


DIAGRAM 2.

"The series system is limited in its application. It has the disadvantage that, if one link in the chain breaks down, if one lamp goes out, all must simultaneously become extinguished, for the current will be stopped, unless special apparatus, acting automatically, cuts out each lamp as it fails, and thus restores the circuit. It involves the use of high tension currents, and therefore it means danger to person, unless perfectly protected. It has, however, the great merit of requiring light or inexpensive conductors. It is inapplicable to the ordinary incandescent system, though, as I shall show, a new glow lamp (the Bernstein) can be worked on this plan.

"The parallel system is unlimited in its character, though the weight of the conductors increases as the area illuminated increases in an increasing ratio, which renders it impracticable to apply this system to any but small districts. An eminent consulting electrician recently pointed out that to supply an area requiring 100,000 lamps it would be necessary to have two copper bands nearly 31 yards wide and ·4 inches thick. Such conductors would weigh 3,950 tons, and cost £1,500,000 per mile. If in full work they would actually waste energy at the rate of 6,750 horse-power, costing £65,000 per mile per annum. Such enormous conductors and such fearful waste render the parallel system pure and simple financially impracticable.

"The charging system is a system of decentralisation. It contemplates the use of currents of very high tension—4,000 volts—generated in a central station, and conveyed along conductors to subcentres, where they are employed in charging, or exciting secondary batteries or accumulators, used as a store of energy, for the purpose of further distribution at a lower pressure into the houses on either the series or parallel system. The charging system, if it were practical, would remedy all the defects of the parallel system. High tension currents render small conductors practical, because they involve the use of small currents, but unfortunately the use of secondary batteries as accumulators has not yet been proved to be a practical success, and, therefore, this system has not yet had a fair trial. Were these batteries to prove successful, nearly all the difficulties in electric lighting would vanish. A wire the size of a lead pencil would replace the massive conductors required by the parallel system, and electric lighting would become a financial success.

"There are certain modifications of these systems of distribution which require examination. Dr. Hopkinson in England, and Mr. Edison in America, have considerably diminished the costliness of the parallel system by joining up two dynamos in series and by introducing a third wire between them, which has allowed twice the electromotive force to be employed. It has thus diminished the total weight of copper used by five-eighths, that is, three-eighths of the copper required by the simple parallel system is all that is now needed for this new system. All central station systems put up by Mr. Edison in the United States are, I am told, installed on this plan. I do not know of its use in England. Indeed, there is no central station now at work here. This principle of multiple conductors admits of considerable extension. Dr. Fleming has shown that the economy effected is given by the formula :—

$$\frac{M}{2\,(M-1)^2}$$

M being the number of conductors,

so that if five conductors were used, only $\frac{5}{32}$ of the copper which would be required by the simple parallel system would be necessary.

"There is another serious difficulty in distributing electricity practically, and that is the diminution of electric pressure as the distance increases from the source of power, or as the number of lamps used varies.

"There are two modes of distributing currents in practical use on a small scale, which tend to remedy these defects, the one at Brighton by the Hammond Company, and the other at Colchester by the South-Eastern Brush Company, the one at Brighton being regulated by electro-magnetic devices, that at Colchester by secondary batteries. The system in use at Brighton is called the grouping system. It is a combination of the series and parallel systems. Supposing a dynamo producing 2,000 volts and 10 ampères were used to illuminate glow lamps requiring 50 volts and 1 ampère to incandesce them, then by this system groups of ten lamps would be joined up in series of forty steps in this way (fig. 1).

"Now if the dynamo be self-regulating, as all good dynamos should be, then if any group of ten lamps be suddenly extinguished without breaking the circuit no injury or inconvenience would ensue. On the other hand, if any one lamp of the group be broken accidentally, or extinguished purposely, then too much current would pass through the remaining nine lamps; their existence would be endangered, and if they all went out, the whole circuit would be broken, and all the lamps throughout the whole circuit would be extinguished. This happened, as will be shown further on, in Wimbledon.

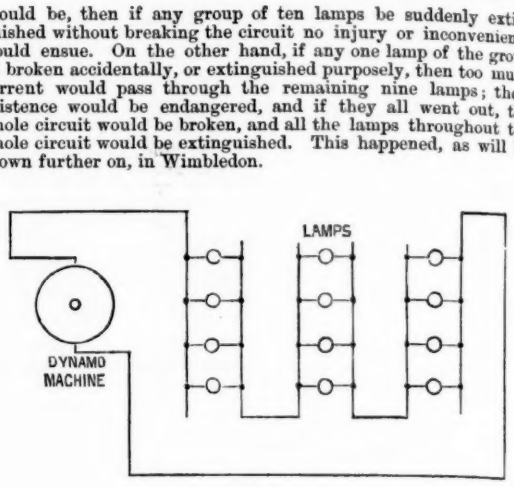


FIG. 1.

"Very ingenious electro-magnetic devices are used in Brighton to throw other lamps or equivalent resistances into the circuit when one lamp fails.

"A very important modification of this grouping system was used at Wimbledon, in which plain, cheap, and simple secondary cells were used as regulators instead of electro-magnets, as at Brighton. Each group had in addition to its quotum of lamps 25 secondary cells, connected thus (fig. 2) :—

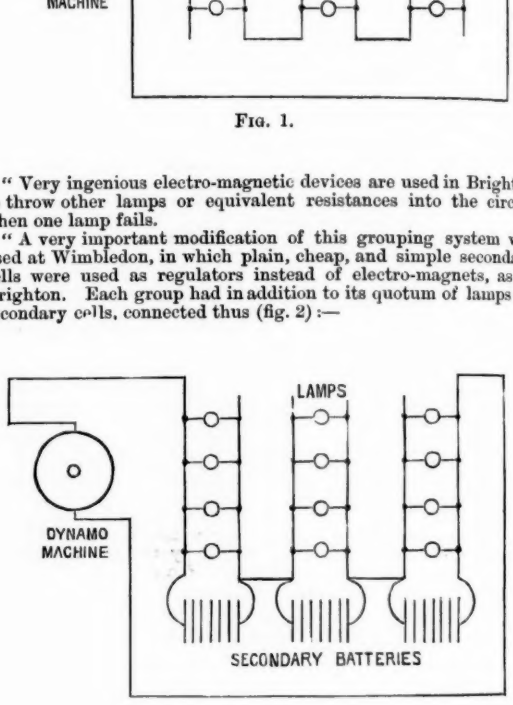


FIG. 2.

"At first the whole of the current would pass through the cells, in consequence of their low resistance, but it would speedily generate a counter-electromotive force, and as soon as this electromotive force reached the maximum of the battery, which was that required to incandesce the lamp, the whole of the current would then pass through the lamp, and none through the battery. If a lamp broke, then the excess of current would pass through the battery, for the battery would prevent the raising of the electromotive force at the terminals of the lamps, which would be necessary to send more current through them, and therefore the current through them would remain steady. This quality of secondary cells is as valuable as their so-called storage power, and it requires only to be understood to be used.

"The system in use in Colchester is called the B.T.K. system, from the initials of Messrs. Beeman, Taylor, and King, who introduced it. Two large Brush machines (known as No. 8), fixed in a central station, are used to charge secondary batteries placed at six different distributing points in the town. The houses and shops are supplied direct from these batteries. The automatic arrangements devised to stop charging when the batteries are full, and to direct the charging current to a second battery, are very ingenious.

"A novel and remarkable system of distributing by secondary generators, that of Messrs. Gaulard and Gibbs, has recently been tried for a short time on the Metropolitan Railway. The results obtained were surprising, and the efficiency of the apparatus proved to be very good.

"In selecting a mode of distribution for practical trial at Wimbledon, I had to take into careful consideration all the advantages and disadvantages of these different systems, and to select that which seemed to be the least objectionable. I had also to decide upon the use of a proper dynamo. My choice rested between the Brush and Hochhausen, and I choose the latter because its currents were more uniform and its efficiency apparently higher. Its behaviour has been admirable, and I am very well satisfied with it. The mode of distributing that I adopted was

the grouping, each group being regulated by a secondary battery, as shown in fig. 2.

"The working was very successful; the secondary cells kept the electromotive force of each group constant. If any lamp failed, the excess of current would pass through the cells, and not through the other lamps, whose light would remain steady and constant as long as only one lamp remained.

"Another advantage was that different kinds of lamps could be used at the same time. A current of 10 ampères was used, and this might pass through ten lamps on one group, giving an ampère to each, or through five lamps taking two ampères each, or through one lamp taking 10 ampères, or any arrangement that would altogether take the whole current, the choice of the lamps for each group being quite independent of the electromotive force, as long as they required the same electromotive force in each group.

"This question of the proper distribution of currents is one of momentous consequence to the future of electric lighting, and it is one that is still in a tentative state. Unless a mode of distribution requiring light conductors can be proved to be practical, the financial success of electric lighting on a large scale is impossible.

5.—The Wimbledon Experiments.

"It was to determine the cost of production and to test practically the question of the measurement and distribution of light and of electricity for public street purposes that the experiments at Wimbledon were carried out. A commodious shed was arranged and placed at my disposal for an engine and dynamo room by the Local Board of Wimbledon. A portable agricultural steam engine of eight-horse-power (nominal) was hired from Messrs. Wallis and Steevens, of Basingstoke. It was one of their standard pattern engines fitted with sensitive governors, such as is used at the British Museum for electric lighting purposes. The engine worked admirably and gave much satisfaction, but it was used far below its actual capacity, and therefore its consumption of fuel was not economical. This engine was connected by American oak tanned belting to a No. 4 Hochhausen dynamo machine, which was lent for the purpose by Mr. Henry Edmunds. The engine-house was supplied with all the requisite meters and indicators to enable the electrical pressure and currents to be read at any moment. Two circuits, partially of solid No. 8 copper and partially of stranded copper wire, made up of seven No. 16's, and giving a resistance of two ohms per mile, were supported on insulators fixed on ordinary scaffold poles placed at regular distances of 100 feet apart. The wire was lent for the purpose by Messrs. W. Glover and Co. The upper circuit extended through the Broadway, and up the hill to the High Street. The lower circuit extended through the Broadway, down the Merton Road and Gladstone Road, returning to the station by the Hartfield Road. Each circuit was about three-quarters of a mile long, and three miles of wire altogether were employed.

"The following table indicates the order and character of the experiments which were carried out:—

No. of Experiment.	Upper Circuit.	Lower Circuit.
1	20 candle-power Swan lamps at 100 feet.	20 candle-power lamps at 100 feet.
2	20 candle-power Swan lamps at 200 feet.	20 candle-power lamps at 100 feet.
3	10 candle-power Swan lamps at 100 feet.	20 candle-power lamps at 200 feet.
4	20 candle-power Woodhouse and Rawson lamps at 100 ft.	10 candle-power lamps at 100 feet.
5	50 candle-power Woodhouse and Rawson lamps at 300 ft.	10 candle-power lamps at 100 feet.
6	50 candle-power Woodhouse and Rawson lamps at 200 ft.	10 candle-power lamps at 100 feet.
7	50 candle-power Woodhouse and Rawson lamps at 100 ft.	10 candle-power lamps at 100 feet.
8	Bernstein lamps of various powers at different distances.	10 candle-power lamps at 100 feet.
9	Maxim lamps of various powers at different distances.	10 candle-power lamps at 100 feet.

"A yard was especially set apart for experimental purposes, and each kind of lamp separately and carefully measured under various conditions.

"No particular care was exercised to secure economy in the engine room. It is difficult to attain this in a temporary installation with an engine not specially designed for the work it is intended to do. Moreover, the expenditure involved in obtaining electrical power is so accurately known that there is no difficulty involved in getting it contracted for at a fixed price known to be just and fair, and therefore there was no object to be gained in studying carefully the efficiency and economy of the motive power arrangements. Horse power developed by the engine can be converted into a definite number of electrical watts in the circuit, the cost of whose production is known, and to supply which responsible contractors could be found.

"I will consider the results obtained under the two heads of Efficiency and Economy.

a.—Efficiency.

"Wimbledon is lighted by oil lamps, having 1-inch flat wicks and burning petroleum oil, of their kind very good when well trimmed and well supervised, but fixed at such distances apart that they cease to become illuminators and act solely as guides. Carelessness and inattention, however, frequently render them useless and offensive. They are left to burn themselves out, instead of being turned out like gas, and lamps are frequently found burning vigorously in bright sun-light. They are not interfered with by weather so much as gas lights. The light they give when in good order is very steady. Their theoretical illumination is 15 candles, but their average light is only 12 candles.

"The gas lamps in the City are supposed to give an illuminating power of 14 candles, when burning five cubic feet of gas per hour, and they do so when burning steadily and regularly in the laboratory, but when placed in the street lamps the supply of gas becomes irregular through age, and dirt in the burner; the flame flickers about through imperfect combustion and through draughts, the lanterns become dim and the glass therefore obstructive, and the result is that the average light given is only 10 candles instead of 14.

"An electrical glow lamp avoids all the defects of the oil and gas. Its average life is 1,000 hours, and it is replaced with ease and rapidity.

"We can make oil, gas, or electric lamps to emit any amount of light we desire within reasonable limits, but as we increase the illuminating power of oil and gas we have to increase the sizes of the lanterns and posts until they attain impracticable dimensions. With electricity, however, we have a power of concentration of light that no other illuminant possesses. In fact it is astonishing how thoroughly the glow lamp lends itself to the illumination of our streets, and how immensely superior it is for this purpose to oil or gas. Experiments were made with glow lamps of 10, 20, 30, 50, and 60 candle-power. That which lends itself best to street lighting, and which gave the most favourable results was Messrs. Woodhouse and Rawson's 50 candle lamp. The most brilliant results were given by the Bernstein 60 candle lamp, but its commercial efficiency was inferior. Table A indicates the efficiency of these lamps when incandesced to their nominal candle power, but if they be incandesced above their normal power, their efficiency increases while their durability diminishes.

TABLE A.

Lamp.	Electro-motive force. Volts.	Current. Ampères.	Candle power (actual).	Efficiency Watts per Candle.
Swan	51	0·71	11·3	3·2
Swan	49	1·31	19	3·37
Woodhouse and Rawson	55	1·15	20·2	2·35
Woodhouse and Rawson	60	2·33	53	2·4
Bernstein	25	5·25	33	4·0
Bernstein	39·75	6·3	66	3·8
Maxim	80	2·16	50	3·45

"No experiments have yet been made to determine the life of lamps at these different states of efficiency, though it is perfectly well known that the higher their efficiency the shorter their career. Since, however, the higher the efficiency of the lamp the less the number of watts per candle consumed, it is evident that there must be some limit for every lamp where the value of its durability just balances the value of its commercial efficiency. It may be a very creditable performance to obtain 2,500 hours' life out of a lamp, and this has been done; but this may have been obtained at an expenditure of power that was commercially ridiculous. The value of the lamp may have been wasted over and over again. The cost of the production of energy is, as a rule, greater than the mere lamp renewal, and the efficiency is of far greater moment than the life. An ordinary 20-candle glow lamp has a guaranteed life of 1,000 hours. This, at 4s. per lamp, is equivalent to ·0025d. per candle hour. The price of a watt in London is ·002d. per candle hour, hence a 20-candle lamp costs in power ·006d. per hour; thus it is easily shown that, if the efficiency be reduced from three watts per candle to two watts per candle, the life might be 555 hours, instead of 1,000 hours, without any alteration in the cost per candle-power per hour, whereas if we were to maintain the lower efficiency, the value of the lamps would be wasted in energy. It is therefore clearly economical to work at a high efficiency, though it entails a shorter life, and the cheaper the makers turn out their lamps the more easily can this be done. Hence there is some state of efficiency for every glow lamp where these advantages and disadvantages are balanced. The duration and scope of my experiments at Wimbledon did not enable me to test this point. The importance of this question cannot be underrated.

"The practical efficiency of the arc lights in the City of London is nearly two watts per candle, and they are renewed every eight hours.

"The practical efficiency of the glow lamps I have used at Wimbledon is a little over two watts per candle, but I never had to renew them at all. If I had incandesced them a little more I might have had to renew them every 100 hours, but I should have obtained the same efficiency from them as from arc lamps. Hence

the supposed economy of the arc over the glow lamp disappears. An efficiency of one candle per watt is not unattainable in the glow lamps, and when that is reached it will equal an efficient arc lamp in economy.

(To be continued.)

TELEGRAPHIC AND TELEPHONIC COMMUNICATION IN FRANCE.

WE give below the text of the bill relating to telegraphic and telephonic lines, recently passed by the French Chamber of Deputies :—

Art. 1.—Operations relative to the establishment, maintenance, and working of telegraphic and telephonic lines, or such others as may be intended for means of communication, belonging to the State, shall be considered as lying under the title of Works of Public Utility, according to the conditions indicated in the following articles.

Art. II.—When it shall be necessary to establish under the soil, the walls, facades, roofs, terraces, in the courts and gardens of private property, of any kind of building, or to establish under roads, and any thing connected with them, especially in sewers, the supports, &c., intended for the service of telegraphic, telephonic, or other lines, a prefect's warrant will prescribe the means necessary for the execution of such work.

Art. III.—This warrant will settle the work to be carried out. It will be made known to the public by means of placards, and individually to those interested where private property is concerned. It will be liable to be carried out, in the case of a primary installation, six days after the notification; and when it refers to maintenance or repair this time will be reduced to 24 hours.

The prefect's warrant will be applicable to all operations entailed by the installation, the maintenance, and the inspection of such line, including the lopping of trees, the branches of which may interfere with the working, no further authority will be necessary.

Art. IV.—The execution of the work mentioned in the municipal warrant, referred to in Article II., the proprietors must give access to the workmen, and put no obstacle in the way of their work.

When the supports are placed on roofs or terraces, the workmen will only be allowed to pass through the inside of the building if access is impossible by outside.

Art. V.—Any indemnities which may be due to the proprietors under the head of damages, will be settled, in default of a friendly arrangement, by the local council, with liberty of appeal to the Council of State.

If the dispute is such as can be arranged by professional opinions, it shall be done by three experts, or by one only, if the parties consent. These experts will be chosen by the council, unless they have been chosen unanimously by the parties in a given time, which will be allotted to them.

Art. VI.—The prefect's warrant, authorising the establishment or maintenance of telegraphic, telephonic, or other lines, will fall through if work is not commenced within six months of its date or within three months of the notification thereof.

Art. VII.—Actions for damages by proprietors, or others, having claims for damages resulting from the works carried out under the conditions of the present law will be null after a lapse of two years.

Art. VIII.—All laws, decrees, and rules are annulled where they may be contrary to the present law.

THE SOUTH AFRICAN CABLE SERVICE.

A MEETING, held at the instance of Baron Albert Grant, took place at the City Terminus Hotel, Cannon Street, on Friday last week, at which was discussed the frequent interruptions in the cable service between England and the Cape and possible remedies therefor. There was a fairly large attendance of merchants and others interested in South Africa.

BARON GRANT presided, and stated that at the wish of two or three firms interested in the trade of South Africa, and also on his own behalf, he had ventured to ask them to come to that meeting with the object, as stated in the notice, of protesting against the way in which the cable service with South Africa had been of late performed. Alluding to a circular sent out by Sir James Anderson, in answer to the charge that the service had not been satisfactory, he said that circular began by saying it was not true that there had been a continuous interruption in the cable service, and then set out the number of days that it had been interrupted during the last three years. He should judge Sir James Anderson's statement by his own circular. He said the total interruptions, spread over 5 years (though he only gave dates for 3½), had been 107 days. These were, in 1882, for 20 days; in 1883, for 51 days; in 1884, for 12 days; and in the first four months of 1885 (not yet expired), for 40 days. He maintained that these figures alone showed the correctness of those who viewed the working of the cable as unsatisfactory. He thought that when commercial firms and the public were told that a cable had been laid in a special district, and especially when that cable was subventionised by Government, they had a right to look forward to a continuous service. When once a cable service was established, all business relations between distant places and England were conducted in a completely different manner. Where commercial firms had formerly relied upon correspondence, they took their measures accordingly, and in the way of remittances, advices, and contracts, they were prepared for the interval of time necessary for the return of post; but when once a cable service was established they had a right to presume upon constant service; and to tell them that the cable was only interrupted for 51 days when the most critical contracts applied to questions put by cable, and which nothing but a cable answer would satisfy, was utterly absurd. That being the case, the question was whether they were entitled to protest. A protest was a very mild proceeding, and did not injure many people, though it had been found very efficacious. Sir James Anderson had been for many years connected with a series of telegraph undertakings, and whatever importance might be attached to him was probably due to his connection with the Brazilian, the Eastern, the Anglo-American Telegraph Companies, and so forth. It was an open secret that all these telegraph companies' shares were at a depreciated value, owing to the extensive "loading" which the cables were subjected to at the time they were launched, and had it not been for the "telegraph ring," which was formed some years ago, telegraph enterprise in this country would have been twice as efficient, and those who had invested would be receiving very different returns. Alluding to his (Baron Grant's) statement that the trade of South Africa was increasing, Sir James Anderson said the traffic was not a growing one, and that the trade on the East and West Coasts would not support a second cable. Well, they all knew that a certain amount of traffic with a limited capital might pay a very handsome return, but on a heavy, swollen capital, for the greater part of which there was no value, would pay a very small return, or none at all. That was the case with nearly all the cables laid down from England. They had been manœuvred and managed by a set of persons who had made large profits out of them, had increased the capital, and so prevented proper dividends being earned, the result of which was that economies were sought to be made which really depreciated the service. Sir James Anderson, whether in consequence of this meeting or of pressure put upon him by the Government he could not say, had confessed that it was necessary to duplicate the line on this section which had been constantly breaking. But in face of the necessity for economy, for the reasons he had stated, two things would occur, both of which would militate against those using the cable—a very high tariff and a very inferior service. He ventured to suggest a remedy, which was a natural one. If an important colony like Cape Colony had not had a continuous communication hitherto, all he could say was it was quite time it had. Take the question of the Government. That the Imperial Government should have been 24 days without any communication with the Government of the Cape at the time of Sir Charles Warren's expedition in Bechuanaland was most monstrous, especially as this cable was laid with the direct stipulation that the Eastern Company should get a minimum subvention from the Government for a certain number of years. The object he (the Baron) had in asking them to come to that meeting was twofold—first, if they agreed with him, to protest against the present system being considered satisfactory, and, secondly, to say that they should have either a duplicate line along the same coast, or, what he thought better, an alternative line on the western coast, which would accommodate many places now without communication, and give them the great advantage of not being dependent on the eastern line; but whichever of these alternatives was to be adopted, he would ask them to say that a second line was imperatively required. He doubted very much if the duplication of the existing line would be sufficient. He proposed for their consideration that a second cable should be laid from the Cape, passing St. Helena, Cape Coast Castle and Sierra Leone, to Cape de Verde, where it would join the Brazilian line. To bring this about, he thought the proper thing to do would be to sign a memorial to the Colonial Secretary, setting forth that he, having guaranteed a certain amount of revenue to this South African section, should either call upon the company to duplicate the line as a necessity for an efficient service, or, if necessary, increase the subvention in order to enable the company to lay a second line. He moved, "That this meeting is of opinion that the service between England and South Africa, owing to the frequent interruptions, is not satisfactory; that a repairing ship ought to be provided so that communications may be kept up by steamer pending repairs; and that representations be made to the Eastern Telegraph Company on the subject."

Mr. HENRY BARKER seconded the resolution.

Capt. MILLS (Agent-General for Cape Colony), said all connected with South Africa must deplore the frequent interruptions, especially at this very critical moment, when immense interests were involved. But there was the contract between the Cable Company and the Imperial and Colonial Governments, which, he thought, must be regarded in the consideration of this question. When this cable was first proposed by the Imperial Government, during the time of the Zulu war, and when it became an absolute necessity, there was an attempt made to lay a cable by the western route, but that was abandoned. The contract provided that the cable should be kept open on the payment of certain subsidies by the Imperial and the Colonial Governments, and that in the event of the cable being interrupted for a period of three months at one time between Durban and Zanzibar, or for six months

between Aden and Zanzibar, the subsidy should stop. Such interruptions had never once happened, and the subsidies had been regularly paid. He (Capt. Mills) had always been of opinion that all cables should run parallel with the lines of steamers, and when the proposal for this cable was made a great number of people at the Cape were of the same opinion, and they urged that if possible the cable should go down the western coast and run parallel with the main line, in order that all messages might be conveyed by steamer when a breakage of the cable occurred. He was of that opinion now, and he should be very glad to see a cable on the western line. But contrary opinions prevailed. With regard to what the chairman had said, he might state that great pressure had been brought to bear upon the company by the Colonial Government, a resolution having been passed in the Legislative Council in 1883 drawing the attention of the Government to the subject, "in order that means might be devised for obviating future interruptions." The company made the one answer which he supposed they would now make, that their interests and the interests of the public were identical, and that if there were breakages they could not help them, and they would avoid them if they possibly could. It appeared to him, taking a practical view of the question, that there were two proposals for relief. One was that of the company to duplicate that section of the cable which had been invariably broken; that was a practical proposal which could now be adopted, and which he knew officially had been adopted. The other way of relief was that suggested by the chairman, and that was a line along the West Coast of Africa. That was a large undertaking, and he was not at all prepared to say that the Government of Cape Colony, which was now paying, and would have to pay for fourteen years, a subsidy of £15,000 annually, would be in a position to subsidise a second line, more especially as it was stated by Sir James Anderson that the single line on the eastern coast did not pay. He was speaking without book; the question had not been considered by the Colonial Government, and he was merely giving his own opinions. There had been representations made on the subject of the tariff, and on the subject of the interruption of the cable, and he must say that the company had shown great anxiety indeed to do all it could to maintain communication, and when it was broken to put ships on the line to carry on the messages.

Mr. SILVERBAUER, as an old colonist, assured the meeting that the people of the Cape were greatly in favour of the western route, which would open up direct communication with important places on the West Coast of Africa. The eastern line, he said, was hastily selected in a time of emergency.

Mr. R. J. JENKINS said the Eastern Company was really out of existence 20 or 25 per cent. of its time, and it frequently happened that messages were sent and no reply could be received to them. Friends in Africa and business men bitterly complained of this.

The motion was then put, and carried unanimously.

The CHAIRMAN moved "That the constant breakages of the cable on the East Coast of Africa involve great interruptions, which are prejudicial to the mercantile community having relations with South Africa, and demand a remedy; and this meeting is of opinion that a second line *via* the West Coast of Africa is imperatively required."

This motion was unanimously agreed to, as also was a resolution that the following memorial be presented to the Secretary of State for the Colonies:—

"To the Right Hon. the Earl of Derby, K.G., Secretary of State for the Colonies.—My Lord—We, the undersigned, engaged in commerce with South Africa, desire to draw your lordship's attention to the very great inconvenience and loss suffered by us from the constant interruptions, for two or three weeks at a time, in telegraphic communication with South Africa, from the breaking of the cable laid on the East Coast. We are of opinion that the great interests represented in South Africa demand a second cable; and seeing that the British merchants on the West Coast have no means of cable communication, this meeting is of opinion that a second line should be laid down to communicate by the way of the West Coast either from the Cape to Lisbon or to join the Brazilian line at Cape Verde, or such other station as may be found most convenient. That the very high tariff (nearly 10s. a word) charged by the Eastern Telegraph Company, of which a great part is guaranteed by the Colonial Department, entitles those having business relations with South Africa to a service without interruption, which by telegraph cable can only be secured by duplicate or alternate lines. We therefore trust that your lordship will be good enough to take such steps as may seem requisite to meet the necessity of the case.—We are, my lord, your lordship's obedient servants, &c."

Etéve's Motor.—On Tuesday last the Self-Propelling Motor Syndicate Company experimented with a new engine, the power being derived from hydro-carburetted air generated by the machine itself from mineral oil of the cheapest description, the explosive mixture being fired automatically by electric sparks. The engine was applied to a small boat on the lake at Hendon, which made several satisfactory trial trips. The inventor (M. Etéve) claims that the motor can be adapted to a variety of purposes, both locomotive and stationary, including the driving of pumping apparatus in mines and elsewhere, and dynamos for electric lighting.

VARLEY'S FLEXIBLE CARBON ARC LAMP.

IT would appear that the several attempts to produce small arc lights have not been, as a rule, attended with such success that the results could be deemed satisfactory in a practical sense. Among other drawbacks, the difficulties of centralising the carbon electrodes when of small diameter, with the attendant flaring and rotation of the arc round the points when out of truth, as well as the few hours the lamp would burn without attention, have prevented this type of lamp coming into extensive use.

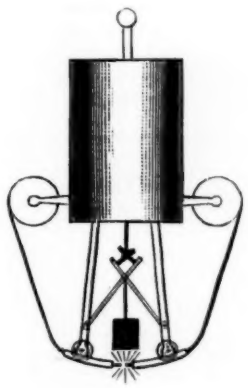
An electrical display took place this week at the Mildmay Park Works, Ball's Pond, belonging to the Varley Electric Patents Proprietary, Limited, and here we observed that some progress had been made towards solving the question of greater subdivision of the arc, and overcoming many of the difficulties heretofore encountered in attaining that end. In the lamps exhibited (the invention of Mr. Varley) the drawbacks beforementioned are said to be absent, and it is claimed that:—

1. The centralising of the carbons and constancy of the arc is secured by the carbons feeding in a horizontal manner (instead of vertically) a kaolin block in suspension over the space between the electrodes, and self-adjusting.

2. The number of hours the lamp is capable of running without attention is practically unlimited.

3. The current necessary is very small, ranging from about two to three ampères, according to brilliancy of arc.

4. About five to seven lamps can be run per H.P., varying from 80 to near 200-C.P. each.



In construction, the lamp (of which the sketch gives an idea) is of the clockwork type, and contains a main coil which operates in separating the carbons, and a shunt coil which works the feed.

When the clockwork is released the carbon is fed through the holders at the extremities of the two levers projecting from the lower portion of the bottom of the body of the regulator, by means of bevil wheels. The carbon, which is flexible, and wound on bobbins on each side of the lamp case, is pushed forward in the fashion of an ordinary lamp wick. The shunt coil, by drawing up the rod attached to the scissor-like arrangement, brings the lever ends together, releases the clockwork actuating the bevel wheels, thus pushing a fresh supply of electrode through the jaws. The resistance of the arc thereby diminishing, the main coil comes into action, reversing the action of the scissors, widening out the levers, and reforming the right length-arc of about $\frac{1}{8}$th of an inch. As the distance between the carbons increases, the flame widens and has a tendency to rise above the horizontal line in a proportion greater than the actual augmented width of arc. To counteract this difficulty, which is the parent of flickering and objectionable shadows, the kaolin block descends as the jaws widen, flattens the flame, spreading it out over the under surface, keep-

ing the arc in its normal position, and in the best locality for emitting the luminous rays.

The lamps are constructed for alternating currents, and in burning are in appearance and colour of light very similar to the Sun lamp.

The carbons consumed in this apparatus are of the well-known Varley flexible carbon cord, prepared in a special manner; they are consequently fibrous, and formed of numerous minute strands joined up in a plaited manner. This arrangement makes a porous carbon of high resistance, although each separate strand is extremely dense and homogeneous. From this results the fact that they burn away entirely, not disintegrating in the customary way with pressed and moulded carbons, thus avoiding a considerable annoyance from the dust. The heated part of these cords is confined within narrow limits, and embraced within the flame, thereby aiding total consumption and dissipation of the elements. The resistance of this carbon per foot is about 10 ohms cold; this necessitates the contacts being very near the extremities and close to the arc, which is also of high resistance, approximating from 15 to 20 ohms.

The lamps can be run either in series or in parallel circuit; as an instance of parallel running, they have been worked in seven parallels with three in series.

Those exhibited were working with a current of 2·27 ampères, measured by a Siemens electro-dynamometer with a potential of, it was said, 37 to 40 volts; the candle-power was considerably over 100, and it had been measured with a larger current to produce 250 candles per lamp.

The light was good, with a slight but not disagreeable tint, and the steadiness was up to the usual standard.

A few mechanical improvements that are about to be made in various details of the construction, should render this lamp an electrical and commercial success. For street lighting alone there should be a large demand, the carbon costing very little relatively to moulded ones, and the amounts of each lamp in candle-power being highly suitable for that purpose, while they can run for some days without attention.

REVIEWS.

Proceedings of the National Conference of Electricians, Philadelphia, September 8–13th, 1884. New York: W. J. Johnston, 9, Murray Street.

This book is a reprint of the full report of the proceedings of the Conference, which appeared in the pages of the *Electrical World*. The work does not call for comment, as the Conference was also reported in columns of the REVIEW. We would say, however, that it is well worth purchasing.

Technological Dictionary of the Physical, Mechanical, and Chemical Sciences. Part II. German-English. By F. J. WERSHOVEN, D.Sc. London: Symons and Co., 27, Bouverie Street, E.C.

This volume is the second of the series, the first of which we noticed in our issue of February 28th, 1885.

BOOKS RECEIVED.

A Handbook of the Teeth of Gears: Their Curves, Properties, and Practical Construction. George B. Grant, 66, Beverly Street, Boston, Massachusetts.

Electric Meteorology. By G. A. ROWELL, assistant in the University Museum, Oxford. Printed for the author for private distribution.

Journal of the Society of Telegraph Engineers and Electricians. No. 55. London: E. & F. N. Spon, 125, Strand.

Universal Reading of Time. By C. E. PARKER-RHODES, 130, Fleet Street, London, E.C.

THE TELEPHONE AND TELEGRAPH COMMITTEE.

AFTER a brief Easter recess this committee resumed their enquiry a week ago, under the chairmanship of Mr. George Russell. Having at their previous sittings disposed of that part of their investigation most concerned with the Post Office and Telephone Companies' interests, they next turned their attention to the case of local authorities. On this branch of the subject,

Mr. G. N. JOHNSON, Chairman of the Commissioners of Sewers for the City of London, was the first witness examined. In the course of his evidence he said he had had occasion officially to give much attention to the use of wires in the City, and his opinion was that legislation was much needed. If it were possible to put all the wires underground the Commissioners believed that would be undoubtedly the best course, but the difficulties were very great if not insurmountable, chiefly on account of the enormous cost. They also thought that the difference between the action of the telegraph and telephone wires would warrant separate treatment, so that the telephone must be overhead and the telegraph underground. If the whole of the expense of putting the wires underground were thrown upon the telephone companies at first, it would be too large for them to encounter; still, if the expense were undertaken it was probable that the companies would be able to pay the necessary amount to cover the original expense. In his view this charge should not be out of the rates, but the rentals charged for the wires should be made to recoup the original expense. As to control and administration of the law, Mr. Johnson said he would at first entrust it to the local authority having control of the streets. In the City of London and in other places there existed a staff which might be utilised to exercise control; but he feared that some difficulty would arise if too much discretion were given. If, however, the Act of Parliament were to define how the wires were to be carried, either above or below ground, some definite directions should be given that it would not be beyond the scope of any local authority to see that the restrictions were observed. He considered it extremely desirable and necessary that bye-laws relating to wires should be subject to the Board of Trade, or some other department of the State; and as to capital required for making subways for the wires, he thought it not unreasonable that the Public Works Loans Commissioners should advance it, and repay themselves by means of a rent or some other such method. At the same time, he was afraid that the making of subways would be too heavy an undertaking for the companies, at any rate at the present moment; but if they were to be made, then he would give to local authorities the necessary power to make such bye-laws as were suitable to their respective districts. In that way he would preserve the right of control and regulation to the local authorities, but something like uniformity of regulations all round would be necessary for the efficient carrying on of this business. Mainly on account of the immense cost, he disapproved of the idea of constructing subways in the City of London, and he thought it would be well to adopt the Post Office system of putting wires under the ground close to the kerb. That system would be preferable to overhead wires, for already there were ten times as many overhead wires as there were a few years ago, and the increase of these wires was becoming really alarming. So close were these wires that in the event of a heavy snow storm or a strong gale there would be serious danger of the wires coming down; but, still, as there were scientific reasons for putting telephone wires above ground, he was afraid they must so remain, and the only way of relieving the strain would be by placing telegraph wires beneath the ground.

Lieut.-Colonel HEYWOOD, engineer to the Commissioners of Sewers, being the next witness called, informed the committee that in his official capacity he had seen with alarm the rapid increase in the number of overhead wires in the metropolis. This increase was so great that these lines now constituted a public nuisance. A return giving the number of wires in the City showed that across Moorgate Street there were 320 wires; across Coleman Street, 320; across Leadenhall Street, in a length of 1,414 feet, 240; across Fenchurch Street, in a length of 1,700 feet, 160; and across Queen Victoria Street, in 2,000 feet, eight large cables and 408 wires. At Ludgate Circus you could count 142 wires and two cables. In King Street, leading to the Guildhall, there were six cables and 74 wires in a length of 520 feet. Cannon Street had seven cables and 360 wires. In some streets there were from 1,200 to 1,500 wires to the mile, and the mean for the City was about 1,000 to the mile. In many places they seemed to darken the air. He admitted that so far the accidents from these wires had been very few, and he had only heard of two; but this admission he qualified by pointing out that as yet the wires were too new to have been much affected by the atmosphere, and that the risk would increase in proportion to the number of wires and in proportion to the number of persons in the streets. The latter reason increased the element of danger in the City. The night population of the City was very trifling—not more than 50,000 or 60,000; but for ten hours in the day there were about 350,000 people in the City, and the population passing in and out of the City daily was something like three-quarters of a million. In his opinion these wires ought to be laid underground, and he held that the public ought not to be subjected to the risk of accident, even though the risk at present was slight. No doubt the cost of putting the wires beneath the ground would be enormous, but the public interest and safety required that that should be done, and he was not disposed to think that in reality this expense would be

fatal to the development of the telephone enterprise. He anticipated that in the future it would become necessary to construct large subways in which to lay telegraph, telephone, and electric lighting wires, water and other pipes, pneumatic despatch tubes and pneumatic clock tubes. As to the control of wires, he felt that the general regulation should be in the hands of the Board of Trade, while the respective local authorities should see to the proper execution of the works, just as they controlled gas and water undertakings for the protection of the public. To ensure public safety, it would be well to impose the very heaviest penalties, and to hold the companies and not the local authorities responsible for accidents and injury.

Mr. FRANCIS H. FOWLER, Deputy-Chairman of the Metropolitan Board of Works, gave evidence as the representative of that body. He admitted generally that the telephone was becoming a public necessity, and therefore ought not to be too much fettered; but he urged that greater power of control than now existed ought to be given to the authorities in regard to erecting further wires.

At the next sitting of the committee, the first witness heard was,

Sir ARTHUR HOBHOUSE, who attended as the representative and at the request of the St. George's Vestry. He stated that that vestry had had very little experience of wires, because until the wires fell and caused an obstruction they had no jurisdiction. They had had complaints of wires falling, but no personal injury had resulted. Some of the metropolitan vestries desired that the control should be in the vestries themselves. The St. George's Vestry had never contended for that, but they desired that, inasmuch as the matter was of great public interest, and the law was entirely insufficient to deal with it, there should be some public authority having the control over the laying and the maintenance of the wires. As to the sort of control to be exercised, that was a question of considerable difficulty, and on which there was a great difference of opinion amongst the vestries. The St. George's Vestry could not see their way to ask that the vestries themselves should have a veto upon the establishment of a wire, because wires extended over districts larger than the jurisdiction of the vestries, and consequently conflicting views might arise. On the other hand, the St. George's Vestry were strongly of opinion that the details of laying and maintenance of the wires were the proper subjects of strict local control, and they had passed resolutions on the subject as follows: "That it is necessary to create some central authority other than the existing local authority for the purpose of deciding whether power should be given to erect wires in cases where it is proposed to lay wires extending over an area subject to more than one local authority; that such central authority should be either the Metropolitan Board of Works or the Board of Trade; that such central authority should have jurisdiction over the erecting of wires from point to point, or within certain lines of deviation; that all questions relating to the mode of erecting such wires and to maintenance and supervision should be left to the decision of the local authority; and further, that all questions relating to wires entirely within the area subject to the local authority should be left to the decision of the local authority." To point out the cases in which there was a dividing line between the jurisdiction of the local authority and the central authority, there was the Electric Lighting Act, by which the whole power was vested in the vestry. The Act said "that notwithstanding anything in the Act, the undertakers shall not authorise any line along, over, or across any street without the consent of the local authority." A provisional order might overrule that—and, in fact, that was done when the vestry remonstrated, and the Board of Trade inserted provisions maintaining the authority which was given by the Electric Lighting Act. There the Board of Trade gave the power to lay the line, and when the line came to the streets then the local power fastened upon it, and nothing could be done without the consent of the vestry. The Electric Lighting Act gave a power of absolute prohibition to the vestries, but not until some public annoyance was created had the vestries any control or jurisdiction. In the view of his vestry central authorities should have power to make bye-laws, but the vestries should have the control of construction and supervision, and should possess jurisdiction in respect to such matters as the span or angle of a wire taken across a street. It did not appear to him that there could be uniformity of regulations, because in some cases it might be more advantageous to put the wires under ground and in other cases overhead, according to the circumstances. In the same way the spans or the posts might have to be varied, but these points might be settled by the respective local authorities. The power that should be given to a central authority would be to lay the wires from point to point or within certain lines of deviation. For instance, a company might receive power to place wires from Westminster Bridge to Paddington Station, and the central authority should have the power of saying that they should not be erected in overcrowded places. The central authority should not frame bye-laws on every subject, for some discretion must be left to the vestries. They should have complete powers as to the ownership of the wires and inspection, and as to the strength of posts, and this would involve some registration, but he would not make it compulsory to register. He had had a wire placed over his own house, but he intended to ask the company to enter into an agreement to remove it whenever he desired. In a company with which he was connected they had demanded 6d. a yard as rent for the wire, and this had been agreed to. That was merely to preserve their legal rights. So far the wires in the St. George's district had done no damage, but if they became merely a source of danger the vestry would have no power—only if they created an annoyance or nuisance. Finally, Sir A. Hobhouse having claimed "by virtue of his house, dominion from the centre of the earth to the moon," said he did not oppose the idea of overhead wires entirely, and admitted that the cost of making subways would be a serious difficulty.

Mr. CHARLES MOSSOP, Chairman of the Electric Lighting Committee of the Chelsea Vestry, expressed the opinion that vestries and district boards should be invested with authority over the wires, and pointed out that the existing dual authority of the vestries and the Metropolitan Board of Works caused delay. The Chelsea Vestry had passed a resolution to that effect, and having sent it to all the other vestries, they had received already fifteen replies, thirteen of which approved the resolution. It was argued that the vestries, having several local officers, must necessarily be better able to deal with this matter than the Metropolitan Board, which had only one such officer, and, in point of fact, that principle had already been settled by the Electric Lighting Act, which provided that under no circumstances should the Metropolitan Board be the local authority for the purposes of that Act. Then again, as such places as Manchester, Leicester, and other large towns would come under the Act, it could not be supposed that they would submit to having to appeal to the Metropolitan Board of Works.

Sir JAMES MCGAREL HOGG observed that there was no intention to place those towns under the Metropolitan Board; and Mr. GRAY remarking that there would be difficulty in having different bodies to appeal to,

The CHAIRMAN (Mr. G. Russell) stated that there would have to be a different appeal in the case of London and the provinces.

Mr. MOSSOP further said his objection to the Metropolitan Board was, that to make that the authority would be contrary to the precedent established by the Electric Lighting Act, and would also introduce the element of arbitration, and that would work badly. For instance, if a dispute arose between the Chelsea and St. George's Vestries, and the question were referred to the Metropolitan Board, Chelsea would have only one member to advocate its cause, while St. George's would have two, and so the tribunal would not be impartial.

Mr. RUSSELL observed that this was certainly a good point.

Mr. MOSSOP, again resuming, stated that he had drawn up a report for his vestry upon the United Telephone Company's Bill, in which he reported that, having regard to the value of the telephone to the commercial world, and to the power provided by that Bill for erecting and testing wires, they might be erected overhead without danger to the public. The cost of underground and overhead wires was as £350 to £10 per mile; and inasmuch as with proper supervision overhead wires could be made safe, he thought the overhead system might be allowed rather than the public have to wait for a system which increased the cost thirty-fold, and would proportionately enhance the cost to subscribers.

Mr. GREENWELL, on behalf of the Marylebone Vestry, spoke in favour of the existing local authorities being the authorities in this matter, with an appeal to the Metropolitan Board of Works, or, if Parliament objected to that, to the Board of Trade. His vestry preferred the Metropolitan Board as the court of appeal, because that body had been most identified with the local authorities, and most distinctly represented the Metropolitan public.

Mr. EDWARD BIRD, of the Fulham District Board advised that the control of wires should be left with the district boards, under the Board of Trade as the central authority; and

Mr. ADAMS, of the Islington Vestry, said that body preferred the Board of Trade to the Metropolitan Board as the appeal authority. He mentioned that in Islington a man had been nearly decapitated by a wire, and as yet no hurricane had occurred to try the strength and stability of the wires.

The Electric Light in Ireland.—The seat of J. Wilson, Esq., Daramona County, Westmeath, Ireland, has recently been lighted by means of the electric light. The motive power is derived from a small waterfall, situated about half-a-mile distant, the current is conveyed to the house by means of bare leads, supported on poles and insulators. The lighting of the house is effected with incandescence lamps, working off Frankland accumulators. The current is supplied during the day from a dynamo driven by a turbine. At a grand ball given there recently, the ball room was brilliantly lighted with the electric light, when no fittings whatever were employed, the incandescence lamps (20-candle power) being supported upon the shrubs, trees, and floral decorations of the room. A very pretty effect was introduced by placing some of the lamps in large bowls containing tinted water, and another and refreshing one, by burying looking glasses in moss and ivy, and incorporating with this latter lamps of 10-candle power in such a way that the lamps were not visible, so that the arrangement resembled little crystal ponds. The work was carried out jointly by Mr. W. E. Wilson and Messrs. A. R. Sennett & Co., by whom the accumulators were supplied.

NOTES.

The Electric Light in the Royal Navy.—In accordance with Admiralty orders, the sloop *Mariner*, Commander J. Durnford, stationed at Devonport, has now been fitted with the electric light, and the ship has been lighted up in order to test the working of the new system. The experiments have been most satisfactory. The type of machine fitted on board the *Mariner* is the D 2 Victoria dynamo, compound wound. The details are as follows :—Speed, 425 revolutions; current 100 ampères; electromotive force, 80 volts; and steam pressure, 50 lbs. In the engine-room Brotherhood's three cylinder engines have been fitted in a suitable position, and the machine will supply a search light equivalent to 25,000 candles, or ten simultaneous lights equal to 10,000 candles; whilst it can also be used for burning incandescent lamps or glow lights, as well as for arc lights, such as are used for lighting railway stations, coaling depots, ships at wharves, &c. The advantage of having such a powerful search light cannot be overestimated in these days of torpedoes and other submarine explosives, and no doubt ere long the Admiralty will find it incumbent upon them to direct that the whole of the ships in the Royal Navy shall be fitted with the electric light for their protection in times of war. The engine-room and stokehole of the *Mariner* are illuminated with 60 volt Victoria glow lamps of 20 candle power. Six are found sufficient to thoroughly light the engine-room, three being arranged as bulkhead lamps, and the remaining three in a group, so ingeniously arranged as to make a reflection by which the working parts of the engines can be seen and manipulated. These lamps are found ample for the stokehole, and they illuminate the water gauge glasses and steam pressure gauges, and produce ample light for the men working the fires. Some of the other parts of the ship are similarly lighted, and there are portable lamps fitted for the coal bunkers. The speed necessary for the working of the 60 volt lamps is only about 340 revolutions, and, consequently, there is little vibration, and no undue noise.

The experiments on board the *Colossus*, at Portsmouth, have been equally satisfactory, and have well exemplified the great value of the electric light for naval purposes.

At a dinner given a few days since to Admiral Sir G. T. Phipps Hornby, K.C.B., on board H.M.S. *Vernon*, torpedo ship, lying in Portsmouth Harbour, the cabin in which the meal took place was lighted with the electric light.

Electric Lighting in Bradford.—A distinct step in advance in favour of electric lighting in Bradford has been made by Messrs. Thorpe and Company, retail warehousemen, of Tyrrol Street and Ivegate. For some time past this firm has suffered great inconvenience by reason of the many rooms in their large establishment becoming intolerably hot through the large quantity of gas they were compelled to burn. To obviate this difficulty, the firm decided on laying down the electric light, and the contract for carrying out the work was secured by Messrs. John Roper & Co., of Bradford. Fifteen arc lamps of 1,200 candle-power, fitted with large ornamental globes, have been hung in different parts of the shops. Seven in the windows, one in each of two doorways, and six in the shop proper. The dynamo is a 15-lighter, and it is driven by a 16 horse-power Crossley gas engine, specially fixed for the purpose. The lamps are so arranged by means of switches and resistance coils that any number of them may be turned off without disturbing those left in circuit. The light was turned on for the first time on Saturday; and, being the first installation of arc lighting which the public of Bradford have had an opportunity of seeing, it attracted much attention. It is stated that it gives much satisfaction; Messrs, Thorpe's customers being enabled to distinguish the colours of goods with as much facility as in daylight.

Lighting the British Museum.—In the House of Commons, on the 16th inst., Mr. D. Grant asked the Chancellor of the Exchequer whether he had arranged to provide the lighting funds asked for by the trustees of the British Museum, so that it could remain open until 10 o'clock at night every weekday throughout the year. The Chancellor of the Exchequer: I have to inform my hon. friend, in answer to this question, that no application, so far as I am aware, has been recently made by the trustees of the British Museum. In 1883 the trustees applied for funds to light some of the Natural History Galleries at South Kensington, and they were informed that "before their wish could be further considered it would be necessary that a complete estimate should be laid before the Treasury of the cost it involved, not only in the erection of plant, machinery, &c., but in the permanent increase that must be apprehended in the charge for services and salaries." They have not furnished us as yet with this information.

Electric Lighting Regulations.—The following regulations governing the introduction of electric lights into buildings were adopted by the Board of Fire Underwriters, of St. Louis, Mo., to go into effect on April 16th :—"That the machine be perfectly insulated from the ground; that the wires start at as great an angle from each other as practicable; that they start on their journey in opposite directions; and that under any circumstances they be not allowed to come nearer together than one foot; that all joints of wire in the building be soldered without acid; and that, as far as practicable, they do not come nearer than one foot from any iron, and that when they come nearer they be protected by double covering; that all lamps be closed at the bottom, and that the lamps be insulated."

The Electric Light and Throat Diseases.—A small incandescent lamp has been made use of in examining General Grant's throat.

The Electric Light and the Growth of Plants.—Mr. Peter Henderson contributes the following interesting remarks to the *Scientific American*:—In conversation with Mr. Isaac Buchanan, one of the best known florists of New York, this subject came up, and he stated that his observation inclined him to believe that when plants were used for decorative purposes in rooms where the electric light was used instead of gas they seemed to have all the health and vigour of growth under the light of a conservatory. He furthermore said that he had long ago observed that on moonlight nights there was always a better development of the flowers of camellias and roses during the winter months than when there was no moonlight. Hence he inferred that light, no matter how obtained, was beneficial to the growth of plants. This opinion from such an authority as Mr. Buchanan, who is well known to have had nearly half a century's experience, and who has always been a close observer, is certainly worthy of great attention. It is well known to all cultivators that the greater the amount of sunlight the greater will be the development of the flowers. We all know that in the dark days of December and January the growth development of rosebuds, carnations, &c., is less than half of what it is in the months of March and April, when the days have lengthened and the increased sunlight gives nearly twice the amount of light. Few commercial florists have the means or time for such expensive experiments as would be necessary to determine whether the use of the electric light in forcing flowers and fruit in greenhouses during winter could be profitably employed. It is a matter of sufficient importance, it would seem, for the Agricultural Department at Washington to take hold of. For be it known that the gardening industry now in the forcing of vegetables, fruits, and particularly flowers, has millions (of dollars) of capital invested in it throughout the land, and gives employment to tens of thousands of men, and if nature can be aided by this wonderful electric light it will be a leap forward that the discoverer might well be proud of.

Steamship Lighting by Electricity.—A new steamer, named *Kathleen Mavourneen*, has just been launched at Liverpool, for the Liverpool and Drogheda service of the Drogheda Steam Packet Company. She has been fitted up in the most approved manner, and lighted throughout with the electric light.

Lord Thurlow and the Electric Lighting Act.—A representative of the *Pall Mall Gazette* recently held an interview with Lord Thurlow, during which the Electric Lighting Act was discussed. Replying to a remark that the committee over which he presides repealed the 27th section (the purchase option clause) in the draft Bill which it has prepared, Lord Thurlow said:—"We have done this because we believe that no modified purchase option clause will meet the requirements of the case. We have found it impossible to hit upon what we think would be a workable and acceptable compulsory purchase clause. I quite admit that as the electric lighting industry progresses, and its risks are more fully understood, capital may be obtainable notwithstanding that the community may have compulsory powers to buy the undertaking after the lapse of a reasonable period; but it is right that the pioneers of a new industry should be encouraged and favoured, and I think it is only fair that the electric companies who take the initiative in this work should be placed on a footing of equality with their powerful competitors the gas companies." "And what would you propose as a reasonable period after the success of central station lighting has been proved?" "Fifty years. That would give the business time to recoup itself for outlay and inevitable risk during the experimental stage, which may extend over many years and without charging a prohibitive price for electricity. It would also afford a fair encouragement to capitalists to embark in the enterprise. They could look forward to holding their property for some years after they had made it dividend paying. The gas companies were allowed to do just as they liked, whereas we are treated at the very outset as if we were introducing something that had better not be introduced. But I wish it to be particularly noted that we do not ask to be allowed to do as we like, we do not even ask for a monopoly. There can be no monopoly in electric lighting, for there are so many different systems to compete for the business to be done." "There is one thing I should like to mention," continued his lordship, "and that is as to the opinion which I find prevailing to a large extent among electric light companies as to Mr. Chamberlain's views. It is strongly believed that he is prejudiced against the electric light. Now, I believe that to be perfectly unfounded. I have never lost an opportunity of telling electricians that they are labouring under a mistake. I know from Mr. Chamberlain's own lips that he has no prejudice against the electric light, and that he is not unduly swayed by fears of injuring the existing gas monopolies. Of course, he has to protect their interests to a certain extent, and he is, above all, timorous and fearful of setting up another monopoly. And we have explained to him that we do not want a monopoly. All that we want is to be put on an equal footing with gas, so as to be able to compete with an existing monopoly. That is a very different thing from setting up another monopoly." Lord Thurlow also expressed his opinion that in the event of an amendment of the Act, electric lighting would at once make prodigious strides, and commented upon the want of a good meter, which, however, he said was only a matter of time. Upon the question of a constant supply, he said they had conceded that point, as they considered the difficulty could and must be got over.

Legality of Telephonic Conversations.—A Kentucky judge has decided that "by telephonic means persons are as much together for purposes of conversation, and actors in what is occurring, as if they were immediately present with each other," and from this he rules that contracts made by telephone are binding, even though the parties do not see each other or have never seen each other.

Telephonic Charges.—At a meeting of the Leeds Chamber of Commerce held last week, the question of telephonic charges was discussed. It was stated that in French provincial towns where there were more than 200 subscribers the charge was 150 francs, or £6 per annum, and where there were fewer than 200 subscribers the charge was equal to £8 per annum. In Berlin the charge was 150 marks, or £7 10s. per annum; in Austria 80 florins, or £6 10s.; in Italy £6 6s. within 250 lire, or £9 10s. without that radius. In Sweden the charge was 80 crowns, or £4 10s. In England, however, they paid as much as £15 per annum for the same use of the telephone, the one notable exception being in Dundee where the price was £5. There are two companies at work in Dundee, and a subscriber might join both their exchanges for £5 less than it was possible to join one exchange in most English towns. It was urged by several members that the Government should take the same course with regard to telephones as it had taken with regard to telegraphs. The matter was ultimately submitted to the Council of the Chamber to obtain fuller information.

The *Leeds Mercury* commenting on the foregoing, characterises the present telephonic service in Leeds and the clothing district of the West Riding as unsatisfactory. It is costly and insufficient, and, if the enquiries which the Chamber of Commerce has resolved to institute result in any improvement of the existing condition of things, the trade and industry of the district will be proportionately benefited. There is no reason why the public should submit to pay excessive charges because the telephone companies have handicapped themselves by paying exorbitant prices for royalties on inventions. The present charges are to a large extent prohibitive, and if it is possible for a service to be worked in Dundee for £5 per annum, it is equally possible to work it in Leeds and elsewhere in Yorkshire. The *Mercury* trusts that the action of the Chamber of Commerce will receive the support of the public.

The Plymouth Telephone Exchange.—In order to still further popularise their Plymouth Exchange, the Western Counties and South Wales Telephone Company has decided that subscribers shall henceforth have the privilege of being "switched" on to the Theatre on any evening when operas or entertainments in which music plays a prominent part are being performed. The company also announces its willingness to connect at a small cost any place of worship with the home of an invalid, so that the services at a church or chapel can be participated in by those who are unable to leave their homes. Many will doubtless avail themselves of this benefit.

Proposed Cable between Western Australia and the Mauritius and Natal.—The Mauritius correspondent of the *Natal Mercury* says: "The question of laying a cable from Western Australia to Mauritius and Natal has just been referred to a full committee of the Council of Government. Some fears were entertained by Sir James Anderson that the weather is so bad between the Australian Coast and Cape, *via* Mauritius, as to render it next to impossible to effect repairs in the cable. Before submitting the papers to Council, they were referred to an able meteorologist, Dr. C. Meldrum, F.R.S., for his opinion on the question raised as to the meteorological and physical difficulties that are alleged to exist in the way of repairing and maintaining the cable in the sea between Australia and Mauritius. Dr. Meldrum has given it as his decided opinion, based on close observations, extending over 30 years, that, as regards storms, a telegraphic route to Swan River or Northwest Cape to Natal, *via* Mauritius, would be safer than the telegraphic route between Ireland and Newfoundland."

The Interruption of the South African Cable.—The Eastern Telegraph Company notifies that a mail steamer will leave Zanzibar for Mozambique to-day.

Proposed Cable to Hongkong and Singapore.—The *Times* correspondent at Hongkong telegraphs :—"The Colonial Government has at last recommended the furnishing of the cable and torpedo boats which I have pressed for in the *Times* for months past in my telegraphic correspondence." The following resolution has been passed by the Council of the London Chamber of Commerce and forwarded to Her Majesty's Secretaries of State for Foreign Affairs and the Colonies and the Chancellor of the Exchequer :—"That, in view of the great importance of British mercantile interests in the East, more particularly as concentrated at Hongkong, the shipping tonnage of which entered and cleared in 1883 amounted to 6,882,000 tons, the yearly imports and exports exceeding 4,000,000 sterling, strong representations be made to the Government as to the imperative necessity of protecting British interests in the China seas by adequate defensive precautions, both at Hongkong and Singapore, and that these two important ports should be without delay united by a direct submarine telegraph cable, entirely in British hands, even if a small Imperial subsidy (as in other cases) be requisite to insure its being laid." This action was taken on receipt of a telegraphic communication from Hongkong notifying the decision of the Legislative Council in the same direction, and urging the London Chamber to support it.

Admiralty Telegraph Wires.—The authorities at Devonport Dockyard have received an intimation from Whitehall to the effect that during the present state of public affairs the Admiralty telegraph wires are to be reserved for the transmission of messages having reference to the fleet now fitting out for sea, and for other matters of pressing importance.

The Central Asian Telegraphs.—With reference to the telegraphic facilities possessed by the Russians in Central Asia, the *Times* correspondent at St. Petersburg telegraphed on Tuesday as follows :—"I have taken great trouble to ascertain, both from official and independent private sources, whether the field telegraph yet reaches Merv ; and have every reason to believe that the paragraph in the *Kavkas*, quoted by Mr. Marvin, which was copied from another newspaper, is inexact, and that the wire from Askabad to Merv cannot be in working order until the 27th of this month, or thereabout. The cable under the Caspian, between Baku and Krasnovodsk, has now been damaged, and all telegraphic communication with the Transcaspian will for the present have to be made through Persia."

With respect to the question as to the time necessary to despatch a message from St. Petersburg to Penj-deh, Mr. Charles Marvin on Saturday pointed out in the newspapers that if the statement published in the *Kavkaz* (alluded to by us last week), that a telegraph line has been constructed from Askabad to Merv, be incorrect, there is still the unquestionable authority of M. Lessar that at least part of the distance has been covered, as in a recent interview he admitted that the wire had been carried "50 or 60 miles beyond Askabad." Mr. Marvin appears, however, still to believe that the line is completed to Merv.

The Berlin Telegraphic Conference.—The *Colonies and India* states that the Victorian Government has been advised that this conference will take place on August 10th. Amongst other things affecting the Colonies, the conference will be asked to consider the request of the recent Australasian Postal Conference, that a reduction might be made in the rates charged for press messages on Indian lines. It appears from communications which passed on this subject that there was no disinclination on the part of the Indian Government to meet the wishes of the Australian Conference, and no objection was raised by the telegraph companies interested, but Germany, as one of the Administrations interested in the telegraphic route to India, objected to any considerable reduction in the rates charged.

Atlantic Cables.—A contemporary on the other side thinks Atlantic telegraphy is still young and undeveloped, and asserts that while its working capacity under certain conditions is known, it is not known how soon these conditions may be altered or at what rates messages may be sent. The rates for messages hitherto have been heavy, it continues, and thus the extent of the work is minimised, but with the increase of the number of cables, and with a growing competition, lower rates will become current, and every year the growth of interest, of business, and of friendly relationship between the two great communities will increase the number of the messages of business, of news, of social life.

Synchronous Multiplex Telegraphy.—At a meeting of the members of the Birmingham Philosophical Society, held on the 16th inst., the president read a paper on Delany's system of Synchronous Multiplex Telegraphy, a description of which will be found in the ELECTRICAL REVIEW for February 2nd and October 4th, 1884.

Army Telegraphists.—Authority has been granted by the War Office to raise the strength of the Reserve of Telegraphists (Royal Engineers) from 70 to 100.

Russian Landlines.—The following table will give an idea of the development of the landline system during the 10 years following 1872 :—

Years.	Mileage of lines.	No. of offices.	Employes.
1872	45117·15	1,330	5,331
1873	47979·05	1,474	6,013
1874	50686·35	1,602	6,393
1875	53868·75	1,768	5,791
1876	56573·79	1,970	7,353
1877	58688·76	2,166	8,111
1878	62089·95	2,326	8,446
1879	65637·00	2,474	8,889
1880	69853·68	2,623	9,300
1881	72167·55	2,733	9,939

The Telegraph in the Soudan.—The *Daily News* states that the military telegraph poles erected in connection with the Suakim and Berber Railway are being fixed with great rapidity. The foundation for the pole is a short cast-iron pile, which is driven into the ground without any digging, hence great stability is obtained. The labour of planting poles by this method is 80 per cent. less than under the old method of sinking a buckled plate in the earth ; two men doing the work of ten. The rigidity of the foundation enables the straining of the wires to go on simultaneously with the erection of the posts. The poles are supplied by Messrs. Siemens Brothers, who have undertaken the sole licence for the use of Legrand and Sutcliff's patent dwarf pile when applied to electric and telegraph purposes.

Sale of Gas Shares.—On Tuesday night, Messrs. Thurgood and Martin offered for sale, at the Assembly Rooms, Upper Norwood, 3,428 £6 Shares in the Crystal Palace District Gas Company, upon which £1 10s. per share had been paid, and which were the property of the late Sir Erasmus Wilson. The shares were submitted in 123 lots, and it was stated that the dividends of the company were at the rate of 7 per cent. per annum. There was great competition at the sale, and the whole of the lots were sold at prices ranging from £2 17s. 6d. to £3 5s. per share, which thus reached a premium value of more than 100 per cent.

Bell Telephones in America.—The net output of telephones by the American Bell Company for the month ended March 20th, it is stated, was 60, against a net of 3,252 last year, a net loss of 594 in February and 298 in January, this year. It is now thought that the company will obtain authority to increase its capital.

Local Authorities and Overhead Wires.—A conference of vestries and district boards was held at Lambeth Vestry, Kennington Green, last week, for the purpose of considering the scheme for the management and control of overhead wires, and appointing three witnesses to attend before the committee of the House of Commons. Mr. F. J. Reid moved, "That in the opinion of this meeting of delegates from the various metropolitan vestries and district boards of works, it is desirable, in the interests of the inhabitants of the metropolis, and as a general principle, that all telephone and telegraph wires within the metropolitan area should be placed underground." (Carried.) It was also agreed, "That the control and the construction and maintenance of all telephone and telegraph wires in the parishes mentioned in schedules A and B to the Metropolis Local Management Act, 1885, should vest in and be under the direction of the vestry or district board of the parish or district in which such telephone and telegraph wires are situate." Mr. Reid then moved, "That in order to prevent any separate vestry or district board refusing arbitrarily the passage of through wires across their parish to the detriment of other parishes, an appeal should be allowed to the Metropolitan Board of Works similar to that sanctioned by section 211 of the Metropolis Local Management Act, with reference to the orders or acts of the vestry or board in relation to buildings, sewers, &c." The resolution was agreed to.

The Electrical Tramcar at Battersea.—At the last meeting of the Wandsworth Board of Works, the General Purposes Committee reported that, accompanied by Mr. Alexander Siemens, they had inspected the electrical car of the Electrical Power Storage Company, and they recommended that permission to use the car from the South London Tramway Company's lines from Victoria Bridge to Wandsworth Road be given, provided that a license therefor be previously obtained from the Board of Trade, and subject to the use of the car being discontinued at any time if required by the board. This recommendation was adopted.

Serious Gas Explosions in the Metropolis.—Since our last issue a number of explosions of gas have occurred in London, causing injuries of a serious nature to several persons. At 9, London Street, Greenwich, on Saturday, the ground floor was wrecked, and a little girl badly burnt; at 17, Vincent Street, Westminster, also on Saturday, a girl of 17 was fearfully burnt on the face, arms, neck, and chest, and a younger girl was less seriously burnt, the premises being greatly damaged; on Monday evening a most destructive explosion at 1, Eugenie Road, Oldfield Road, Rotherhithe, caused shocking injuries to six persons, two of whom are not expected to recover; and on Tuesday an explosion was caused at 146, Southwark Park Road, Bermondsey, by an attempt to discover a leak by means of a lighted candle, Mr. Edwin Morsman being severely burnt on the face, hands, and arms.

A Plea against Underground Wires.—The New York *Electrical World* states that, although by many people treated as a mere pretext of evasion, the argument that to turn up the streets of New York this year, in order to put the wires underground, would invite pestilence, is now echoed and put forward as reasonable by the leading physicians of the city and the Health Commissioners. Apprehending a visitation of cholera, they all say that the exposure of the subsoil, saturated as it is with coal gas, and other noxious gases, would be highly dangerous to the public health. This argument is a new and strong plea in favour of the electric light, continues our contemporary. Excavations of all kinds along the city thoroughfares are to be stopped—and wisely—because the escape of coal gas from the mains has poisoned the soil everywhere; and, for the same reason, breaking up the streets at any time is unhealthy. The use of electric light wires involves no objection of this nature.

The B.T.K. Storage Batteries.—We have received a copy of a report made by Professor George Forbes, and dated March 25th, 1885, in which he gives the efficiency and commercial output of these batteries. Our readers will probably remember that so long ago as March of last year Prof. Forbes was engaged in examining into their working; one would therefore conclude that he has not omitted any one point which should be taken into consideration for arriving at correct results. As we shall probably deal with this subject more fully in our next issue, we will merely mention that the number of cells tested was 18, connected together in series. Mr. Forbes says:—"Several of the cells were not in perfect order, and lost their E.M.F. entirely. Owing to this cause, the efficiency given above (67 to 69 per cent) is not so high as it would have been with better cells." As this sage remark applies to batteries of every description, we can at once dismiss it without further comment. In another part of the report we observe the following:—"A certain amount of bulging was noticed in some of the plates after a lengthy discharge. This would not occur with these plates when properly used." Are we to understand from this that Professor Forbes did not use the plates properly? In the next paragraph we read:—"My opinion is that these cells are good, and that their performance would have been better if they had been better treated before being placed in my hands." However this may be, they were treated as if in actual employment, for the Professor writes:—"I invited your *employés* to supply me with the charging current which they preferred to use, and I discharged at the rate which they adopt in practice." Probably from the effect produced upon the minds of the directors of the Consolidated Electric Company, Professor Forbes was requested to test another battery of 18 cells, under favourable conditions. This test was one of a single charge and discharge, and from it Professor Forbes arrives at the conclusion that the true and practical efficiency comes out 69 per cent.

Electricity in War Time.—Our namesake in America views the present position in regard to England and Russia from its particular standpoint, thus:—"The war rumours have put many an electrician on the *qui vive*. There are many devices in which electricity plays an important part, which would, their inventors believe, prove invaluable in warfare, but the trouble is that wars on a large scale come so seldom, and, when they do come, are so soon over, that the inventors hardly get a chance to show what they have got before the smoke of battle clears away to give place to the white wings of peace. But, if—what is hardly probable—Great Britain and Russia, the lion and the bear, get at it in good, sober earnest, on land and on sea, and some of the other Powers are drawn into the trouble, the 'boys' will have a chance, and, in all probability, a good one, for both nations have money, and neither spares it when it has armies in the field. Should it be declared, we shall expect to see no end of death-dealing contrivances, which have been hibernating for years, come forth to claim recognition. It is very certain that, in the event of it being desirable to explode a mine under a fort, something better than a slow-burning fuse, such as at St. Petersburg, by going out once or twice, caused a fatal delay, would now be used. A couple of wires, a detonator, and a hand-generator would do the business infallibly, and at the exact moment required. Let us hope that 'grim-visaged war' is not to show his 'wrinkled front' at all; but, should he, electricity will play a more important part than ever before."

Meteorological Observations. — Another of the volumes annually prepared by the Postmaster-General, Superintendent of Telegraphs, and Government Astronomer of South Australia, Mr. Charles Todd, C.M.G., F.R.A.S., recording the meteorological observations made at the Adelaide Observatory, and other places in the colony, has reached us. It contains a vast amount of information, which must be of great value to those interested in the particular subject with which it deals.

Electric Meters and Gas Meters.—The *New York Times* has a serious reproach to bring against electric meters. A gas meter was known, it readily grants, to be the most "vicious and dishonest piece of machinery in existence—a machine that would swear to the consumption of thousands of feet of gas in a vacant house where no gas whatever has been burned." But when the electric light was introduced, people in America were led to suppose it would prove an honest as well as a brilliant light, and, as it became generally used in New York, households and heads of families were persuaded they would at length, by discontinuing the use of gas, be charged only for the amount of light they actually consumed. This consoling anticipation has not, however, been realised, for, says the American paper, the "electricity-consuming public will learn with dismay" that an electric meter in the city is proved guilty of having falsely represented that ten dollars' worth of electricity was used during last month in a house from which all the electric lamps had been removed for considerably more than a month. It would be interesting to know, says the facetious journalist, "if the electric meter had ever been associated with a gas meter. If it had spent any time in a cellar in the society of a gas meter it was quite possible that it was corrupted by the vicious influence and degrading example of the latter. That the gas meter does exert a most demoralising influence upon those who associate with it is sufficiently proved by the character of the managers of gas companies, not one of whom ever declines to profit by the false testimony of meters. Persons using the electric light cannot be too careful to remove their gas meters from the cellar before introducing the electric meter. The probability is that the electric meter is honest when left to itself, but that it is weak and easily led away by bad companions."

The Thomson-Houston System. — The Thomson-Houston Electric Light Company has put in operation through its Chicago agency, since January 1st, the following arc-light plants: Atchison, Kansas, 45 lights, afterwards increased to 75; Janesville, Wis., 50 lights; Pontiac, Ill., 27 lights; Freeport, Ill., 30 lights, afterwards increased to 60; Streator, Ill., 25 lights; Racine, Wis., 100 lights. Blomgren Bros., Chicago, have in successful operation a special Thomson-Houston light for photographing purposes. The 50-light plants at Terre Haute, Indiana and Oshkosh, Wis., will be in operation shortly. The Chicago agency is well pleased with the business outlook for the system in the West. The company has just made all the arrangements for putting a plant in at Newport, R. I. It will do all the city lighting in addition to a large amount of commercial lighting.

The Voyage of the "Electra."—The *Electra*, with Mr. John Pender, M.P., on board, after a hurried visit to Lisbon at the beginning of this month, Mr. Pender not having succeeded, we hear, in gaining an audience of the King, left for the Mediterranean, and on arrival at Marseilles at the end of last week was put into quarantine, on account of having previously touched at a Spanish port during the trip.

The Trials of Inventors.—Two German gentlemen arrived in London yesterday, said Thursday's *Standard*, with an invention in the shape of an electric light lamp, which they intended to submit to the Chief of the Metropolitan Fire Brigade. At the Custom House, however, upon the baggage of the gentlemen being searched the officials thought they had come across an infernal machine, and promptly arrested the gentlemen and appropriated the invention. The unfortunate inventors were detained in custody all day yesterday pending the verification by telegram of their statements, and last night, at a late hour, they endeavoured to see Captain Shaw, in order to explain their grievances. An appointment was made for this morning, but the electric lamp had to go untested, for the officials had sent it to Woolwich for the purpose of examination by Colonel Majendie.

Turkish Telegraphs in Arabia.—A telegram from Jeddah is to the effect that advices from the interior state that the Turkish troops occupied in laying the telegraph wire between Mecca and Taif were recently attacked by the Arabs inhabiting the district. Several soldiers were killed in the engagement. In consequence of this affair the Turkish Government has resolved to pay an annual subsidy to the tribes for the maintenance of the telegraph between Mecca and Taif.

Gas Gone Wrong.—A few nights ago the whole of the gas lights in the office of the *Morning Post* suddenly went out, and had to be replaced, in order that the work of producing the journal might be proceeded with, by candles.

Proposed Museum of Scientific Appliances.—At a meeting of the Liverpool and District Association of Science and Art Teachers, held recently, it was proposed that a Museum of Scientific Appliances should be established in Liverpool, which would embrace a collection of machines and inventions used in the manufactures of the country, and models of mechanical, electrical, and other scientific apparatus. There were hundreds of young men, it was stated, who attended the science classes, whose education in these matters was a most potent influence in the prosperity of the country; but until they could see for themselves, and have the various principles explained to them from actual machines, such education could not be satisfactorily carried on. A resolution embodying these views was ultimately passed. At the close of the meeting a collection of scientific apparatus was examined. Some electro-motors, electro-magnetic engines, and a dynamo were at work; the object being to show how an electric current may be transferred into energy, and energy into current, light, &c. Amongst the apparatus driven by the motor were a sewing machine and a circular saw.

Obituary.—We regret to announce the death of Mr. William Ladd, F.R.A.S., at his residence, Burnt Ash Hill, on Thursday, the 16th inst., at the age of seventy. Mr. Ladd was well known in scientific and commercial circles for his efforts in the field of electrical research, for during the decade extending from 1860 to 1870 he took a very prominent part in introducing into practical utility the then comparatively obscure science of electricity. Nor was his interest in this line confined merely to any particular branch of the science, for we find him at one time in correspondence with Professor Reis, of telephonic fame. A letter is still extant, in which Professor Reis explains to Mr. Ladd his views upon this question, and the partial success that attended his efforts. Mr. Ladd was well known as the inventor and constructor of some of the largest induction coils and electrical apparatus manufactured. In 1867 Mr. Ladd brought forward a dynamo machine, which in many respects showed a marked improvement on previous machines, and whereby many of the then existing difficulties in the way of constructing dynamos for practical and commercial use were removed. Somewhat later, in the year 1878, Mr. Ladd was instrumental in introducing into this country the Wallace-Farmer system of electric lighting from America. The dynamos and arc lamps employed on this system underwent considerable improvement at Mr. Ladd's hands, and one of the earliest installations of electric lighting afforded to the public was made under Mr. Ladd's supervision on the above system at the Liverpool Street Terminus of the Great Eastern Railway. Mr. Ladd was, from the time of its formation, a director of the Anglo-American Brush Electric Light Corporation, Limited, and also of the Electrical Power Storage Company; and he took an active interest in the administration of these companies until almost the day of his death.

We have also to announce the death on Wednesday, at the early age of 28, of Mr. Alan Bagot, well known in scientific circles, and the author of several works relating to mining matters.

CITY NOTES, REPORTS, MEETINGS, &c.

Reuter's Telegram Company, Limited.

THE twenty-first ordinary general meeting of the shareholders of this company was held at the offices, 24, Old Jewry, E.C., on Wednesday, Col. Jas. Holland, chairman of the company, presiding.

The Chairman moved the adoption of the directors' report, which stated that the net profits for the year ending 31st December last, after payment of current charges, and deducting rebate on unexpired subscriptions, amounted to £2,103 5s. 7d., including £204 6s. 6d. brought forward from the last account. The military operations in the Soudan and in China had entailed a large additional expenditure for telegrams and correspondents, and the profits had, in consequence, been diminished to a corresponding extent. In order to meet the emergency, the directors, in accordance with the articles of association, had transferred the sum of £2,000 from the reserve fund to the profit and loss account, making the total amount available for distribution, £4,103 5s. 7d. The usual interim dividend of 2½ per cent. was paid in October last, and the directors now declared a further dividend of four shillings per share, making a total distribution, free of income tax, of 5 per cent for the year. This would absorb £3,704 16s., and leave a balance of £398 9s. 7d. to be carried forward. The Chairman, in moving the adoption of this report, stated that the falling off of the nett profits, as compared with last year, was entirely owing to the military operations in China, Egypt, and the Soudan, and especially in the latter. Those districts being beyond the course of their regular correspondents, they had been compelled to employ special correspondents, and a service like that in the Soudan and in Egypt would naturally strike them as one requiring high pay. Great risks were run; and, as an evidence of that, he might mention that one of their correspondents had perished, and another had been very severely wounded. They felt greatly indebted to the gentlemen who had been and who still were their correspondents in those districts, for their zeal, and the highly satisfactory manner in which they had performed their arduous and perilous duties. But those services, though they tended to keep up the reputation of the company—which was a matter of the first importance to them, as a company formed for procuring and disseminating important news—had proved, unfortunately, as might have been expected, anything but beneficial to the shareholders, the expenses having been nearly £6,000 more, while the receipts had increased by only about £3,700. It would, therefore, be a serious and anxious duty for them, as the engagements now standing with the Press fell in, to endeavour that such fresh agreements as would satisfy the shareholders that the very moderate interest which they looked for upon their capital should be made good to them in the future. It was evident that with wars constantly on the horizon the expenses must increase beyond the receipts, unless the receipts were augmented; and the outlook was not at all a assuring one at the present moment.

Admiral Sir John D. H. Hay, Bart., M.P., seconded the motion, which was unanimously agreed to,

Baron de Reuter was re-elected to the direction, and the auditors, Messrs. Quilter, Ball, Crosbie, Clegg, and Welton were also re-elected.

A vote of thanks to the chairman terminated the proceedings.

The Eastern Extension Australasia and China Telegraph Company, Limited.

THE report of the directors for the six months ended 31st December, 1884, states that the gross receipts, inclusive of Government subsidies, have amounted during that period to £248,087 19s. 5d., against £231,056 1s. 4d. for the corresponding half year of 1883, showing an increase of £17,031 18s. 1d.

The working and other expenses, including the abnormally heavy item of £33,746 10s. 1d. for cost of repairs and renewals of cables and expenses of ships, absorb £79,496 9s. 1d. against £69,862 0s. 2d. for the corresponding half year of 1883, leaving a balance of £168,591 10s. 4d. From this is deducted £2,767 13s. 5d. for income tax, and £41,595 for interest on debentures and contributions to sinking funds, leaving £124,228 16s. 11d. as the net profit for the half year, which, with £17,147 18s. 1d. brought forward from the previous half year, leaves an available balance of £141,376 15s. 0d. Against this the directors have charged £20,000 on account of the partial renewal of the Singapore-Saigon and Penang-Rangoon cables.

One quarterly interim dividend of 1¼ per cent., amounting to £31,250 has been paid for the half year, and it is now proposed to distribute another of like amount, together with a bonus of 2s. per share, payable on the 30th inst., making, with the interim dividends and bonus paid for the first half year a total distribution of 7 per cent. for the year 1884. The balance of £33,876 15s. has been carried to the general reserve fund, which now stands at £510,649 11s. 9d.

The investments on account of this fund now include the securities shown in former accounts as standing in the names of the trustees of the 5 per cent. Australian Subsidy Debentures, the same having been sold to the company to provide funds to meet the bonds drawn for payment on the 1st July last.

In pursuance of the conditions upon which the issue was made, 433 of the company's 5 per cent. debentures of 1880 were drawn by lot on the 18th instant for payment at par on the 1st May next.

A new cable steamer, *Magneta*, built for the company by Messrs. Napier and Sons, was despatched on the 8th ultimo to Singapore to replace the ss. *Agnes* which had been ordered home to be overhauled with a view to the repairs reported to be necessary. No tidings of the ship's arrival at Gibraltar having been received up to the present time, the directors are reluctantly compelled to infer that unhappily she has been lost with all hands. The ship was fully insured.

The policy of strengthening the weak portions of the company's system has been continued during the half year by the renewal with brass-ribboned cable of 285 nautical miles of the Singapore-Saigon section and 100 nautical miles of the Penang-Rangoon section. Most of the old cable will, it is anticipated, be picked up and brought into the spare stock of cable at Singapore during the current half year, when the cost of the operation will be shown in the accounts. The cable when re-served will be available for further renewals or extensions.

The principal cable interruptions during the half year have occurred on the Penang-Madras and Java-Australian (original) sections. The former took place on the 13th June, during the height of the south-west monsoon, but was successfully repaired during a lull on the 14th July. Unfortunately, however, the large expenditure of cable shown in Abstract C was principally incurred during this repair in consequence of a return of bad weather immediately after restoration of the communication preventing the recovery of the old cable, which, however, may be picked up when a favourable opportunity offers.

The cable between Victoria and Tasmania was also interrupted in July, and owing to the unusually severe weather that prevailed at the time, was not repaired until the end of September. To prevent as far as possible a recurrence of the inconvenience to the colonies and loss to the company thus occasioned, the directors have determined to duplicate this section (176 knots in length) from its stock of spare cable at Singapore. All the company's cables are now in good working order.

During the past half year the landline belonging to the South Australian Government between Port Darwin and Adelaide has continued to work well

Mediterranean Extension Telegraph Company, Limited.—The liquidators of this company have announced a distribution among the ordinary and preferred shareholders of £2 per share of Eastern Telegraph Company's 4 per cent. mortgage debenture stock.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 17th were £2,897, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th April, are £3,980, as compared with £3,221 in the corresponding period of 1884.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Consolidated Telephone Company, Limited.—An order of the High Court of Justice (Chancery Division), dated 14th ult. and filed on the 9th inst., directs the cancellation and reduction of the capital of the company as resolved upon by the special resolution passed and confirmed at extraordinary general meetings of the company held on the 16th December, 1884, and 6th January, 1885. It is also ordered that the addition of the words, "and Reduced," to the title of the company be altogether dispensed with.

Electropathic Association, Limited.—A general meeting of the members of this company was held on the 20th inst. in conformity with section 142 of the Companies Act, 1862, when an account was given of the way in which the winding up of the company has been conducted and its property disposed of.

Change of Office.—The registered office of the Electric Signal Company is now situate at 15, Finborough Road, West Brompton.

Volta Electrical Company, Limited.—The registered office of this company is situate at 2, Chatham Buildings, Chatham Street, Manchester.

NEW PATENTS—1885.

4631. "Galvanic batteries." R. F. YORKE. Dated April 15.

4647. "Electric arc lamp." H. PIEPER. Dated April 15. (*Complete.*)

4671. "Manufacture of elements for voltaic batteries." D. G. FITZGERALD. Dated April 15.

4688. "Carrier or support for incandescent lamp shades." A. SWAN. Dated April 16.

4717. "Method of and apparatus for commutating circuits for charging successive sections of secondary voltaic batteries." H. P. HOLT, A. E. JONES. Dated April 16. (*Complete.*)

4720. "Wall brackets and suspensions for electric lamps." J. G. STAPELTON. Dated April 16.

4723. "Aerial electric signalling apparatus." F. J. MICKLEWRIGHT. Dated April 16. (*Complete.*)

4745. "Galvanic cells." S. RAUDNITZ. Dated April 17. (*Complete.*)

4771. "Wiring interiors for electric purposes and devices and tools therefor." B. J. B. MILLS. (Communicated by L. Stieringer and J. H. Vail.) Dated April 17.

4787. "Galvanic battery." R. F. YORKE. Dated April 18.

4809. "Electrical storage batteries." S. NORRIS. (Communicated by C. P. Orne.) Dated April 18.

4815. "Electric thermo-telemetry." J. G. LORRAIN. Dated April 18.

4841. "Transmitting lights and shadows by telegraph so as to give photographic or other records of one's own handwriting and even of delicately shaded pictures by ordinary telegraph wires." W. GEMMILL. Dated April 20.

4845. "Reversible electric machine." J. ENRIGHT. Dated April 20.

4854. "Holder for incandescent lamps." H. PIEPER. Dated April 20.

4912. "Electric lighting and electric lamps." A. N. J. CONTARINI, G. M. BRAGGIOTTI. Dated April 21.

4928. "Electric generators." B. A. RAWORTH. Dated April 21.

4952. "Secondary galvanic batteries." G. F. REDFERN. (Communicated by M. Glaesener and J. B. Glaesener.) Dated April 21.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

5695. "Improvements in safety 'cut-outs' for electric lighting and other electric circuits." A. W. BREWTNALL. Dated March 31. 6d. The object of this invention is to provide an improved means for automatically cutting out a circuit in connection with a dynamo, or other source of electricity, when, from short-circuiting, or other cause, the current becomes abnormally great and therefore dangerous in such circuit. The apparatus to be of a form which shall enable its being re-set readily by hand or to re-set itself automatically, without having to provide fresh and separate "junction pieces" each time the "cut-out" is brought into action. This object is effected by making a star-shaped wheel or piece of metal, or other substance, either stamped from a sheet to the requisite shape as shown in fig. 1, *a*, in the accompanying drawings with any convenient number of arms (the drawing showing 8), or by using two or more discs or plates of metal, or other suitable material, held together by screws or other means, one of which is shown in fig. 3, and clamping or holding between their surfaces any convenient number of any suitable form of fusible connections, arranged radially, as shown in figs. 1, 2, and 3. The outer ends of such connections to be bent into a hook, as shown in the accompanying drawings, or to be of such a shape that a lever or arm, being either fixed or pivoted, and actuated by a spring, may engage with any one of them. One form of pivoted arm is shown at *b*, fig. 1, pulled by a spring, *c*, which tends to move the end, *d*, of the lever outwards, away from the star-wheel. The disc, or star-wheel, in the one form above described, and shown in fig. 1, is fitted on to a post with a nut to clamp it when put in position for use. The said post is connected by any suitable means to one end of the circuit wire and the other end is attached to the lever or arm, so that when the lever is made to engage with one arm of the star-wheel, as hereinbefore described, the circuit is completed through the medium of the said fusible portion. When the "cut-out" has been brought into action, and the arm, say No. 1, fig. 1, has been fused, the lever takes up the position shown in dotted lines, and may readily be made to ring a bell to give an audible signal that something is wrong, at the same time uncovering a red disc signal, R, or by other means, giving a visible signal to show which circuit requires attention. To re-make the connection, the nut clamping the star-wheel is loosened, the wheel moved round, so that the arm, 2, can be made to engage with the lever, and then the nut is tightened, and the circuit again ready for use. In the automatic "repeater" form, which is shown in fig. 2, the inventor makes use of a similar disc and arm as hereinbefore described and shown in fig. 1, but in this case the lever is mounted on a shaft which can revolve, having a pinion on it gearing into a toothed wheel on a second shaft, on which the disc or star-wheel is mounted, as indicated, and the two toothed wheels are so proportioned that one revolution of the lever shaft, if fitted with one arm, and half a revolution, if fitted with two arms (which latter

FIG. 1

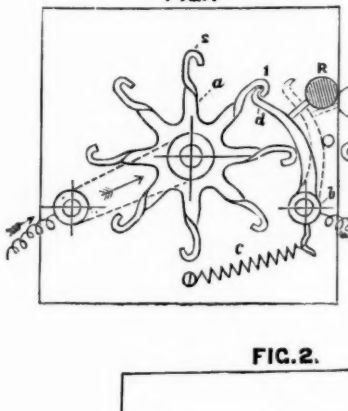


FIG. 3.

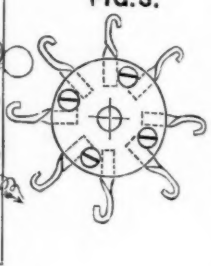
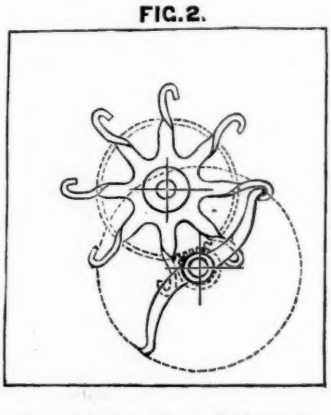


FIG. 2.



form is shown in fig. 2), brings the end of the lever into such a position that it engages with the next hook, or other part of the star-wheel, formed for its reception. One or other of the shafts is to be fitted with a spring weight, or other actuating power, and controlled by a fly, or other governing device, so that when brought into use, and having one arm fused, the parts move as above described and re-make the circuit. The amount of time which is allowed to elapse between the breaking and re-making of the circuit is dependent on the governing device, which can be made to suit any requirements. This form of "repeating cut-out" will be useful when the cause of the increase of current is only momentary, breaking the circuit for a sufficient time for the current to settle down to its normal amount. This automatic form may be arranged so that the circuit when broken will be re-made, say two or three times, and if the cause of the extra and dangerous current is still taking effect, that it will permanently break the circuit and give a signal either audible or visible, or both, to the attendant.

12430. "An electrical pressure alarum." J. LORRAINE. Dated September 15. 4d. The inventor applies to the dial of the pressure guage a spring contact connected by wires to an electrical battery and a bell or gong. Usually the contacts remain apart, leaving the electrical circuit open, but when the pressure index reaches them, it presses them into contact, and the bell or gong is thus caused to sound, informing the attendant that the pressure has reached the desired limit.

12467 "Improvements in electric or other railways." T. P. CHANDLER, Jr. Dated September 16. 4d. The object of the invention (which is similar to the "telpherage" system) is to provide a simple, cheap and durable construction adapted to railway purposes, especially for the conveyance of the mails and small merchandise in large cities or between cities.

12850. "An improvement in electrical signal or call bells." J. D. F. ANDREWS. Dated September 26. 4d. The inventor attaches the ball striker of the bell by an elastic wire to a stem of iron, which lies as an armature between the poles of the electro-magnet, and which terminates at its end in a knife edge that enters a notch in a piece of iron or steel attached to the permanent magnet, which forms the polar field of the magneto machine employed for sending a bell current to a distant station. The stem of the striker, which is magnetised by induction from the permanent magnet, is caused to vibrate when alternating currents pass through the coils of the electro-magnet, and the ball striker, being thus made to oscillate between two bells, causes them to sound. By thus utilising the permanent magnet of the magneto

machine, the magnet usually employed to polarise the bell armature is dispensed with.

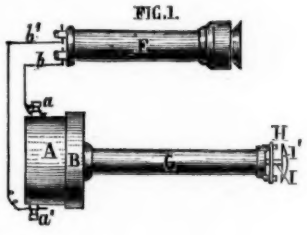
14781. "Improvements in cartridges for electric fire-arms." T. P. WOOD. Dated March 12. 6d. Embedded in a wad of insulating material at the base of the case are the wires whereby the path of the current is continued from the wires in the gun. One of the wires is centrally placed and the other at a distance therefrom to correspond with the position of the wires in the gun. This latter wire is continued round and through a portion of the insulating wad in the form of a ring, so that the cartridge when placed in the gun may be always in position for connection with the wires in the gun.

15580. "Improvements in the art of telephony." C. A. DAY. (Communicated from abroad by J. Lowth and W. D. Ewart, of America.) Dated November 26. 6d. Consists in a method of working a battery-transmitter by contact, with the exterior of the throat of the speaker, of a solid body connected with one of the electrodes, and operating to influence it apparently in the same manner that it would be influenced by the sound waves of articulate speech, induced by the action of the vocal organs, and conveyed to said electrode through the medium of the atmosphere.

15581. "Improvements in telephones." C. A. DAY. (Communicated from abroad by J. Lowth and W. D. Ewart, of America.) Dated November 26. 6d. Relates to certain improvements in apparatus or telephonic contrivances adapted to work by the transmission through the medium of a vibrating rod to the diaphragm in a magneto telephone and to the electrodes in a battery telephone of the muscular vibrations or exterior bodily movements of the speaker, and the present invention more especially consists in certain novel devices and combinations of devices applicable more especially to a battery transmitter telephone working on the said principle.

15582. "Improvements in telephones." C. A. DAY. (A communication from abroad by J. Lowth and W. D. Ewart, of America.) Dated November 26. 6d. The present invention is based upon the fact or discovery that the exterior parts of the human body located near or in the vicinity of the vocal organs—such, for example, as the exterior surface of the throat, and especially those parts near the larynx—vibrate in accordance with the vocal organs during the utterance of words or sounds. These external vibrations are utilised according to the present invention, and as hereinafter described, for the purpose of exciting, controlling, or varying in a telephone the vibrations or undulations upon which depend the reproduction of words or sounds telephonically, and this result is accomplished or effected through the medium of a solid body (as distinguished from fluid, such as air), adapted and arranged to be employed stethoscopically, and the present invention consists in the novel combination of devices, which will be hereinafter more fully explained, by which there

FIG. 1.



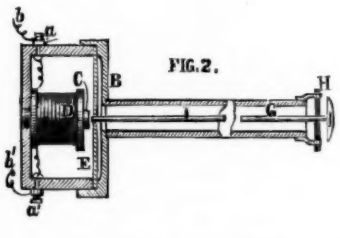


FIG. 2.

can be produced for use a stethoscopical transmitter for telephones more efficient and convenient in operation than any heretofore made. Fig. 1 represents a side view and fig. 2 represents a longitudinal central section on an enlarged scale through the transmitter. The apparatus is made with a comparatively small box or case, A, having a cover or lid, B, applied thereto, and a magnet, C, located within it. The ends of the helix, D, on the bar or core, C, of the magnet, are carried to binding posts, a, a^1, and a suitable vibratory disc or diaphragm, E, is also arranged with its central portion a little way out of contact with the magnet. An ordinary telephonic receiver, F, is used, the binding posts of which are respectively connected by wires, b, b^1, to the posts, a, a^1, of the transmitter at the other end of the line. A tubular extension, G, enters an opening in the cover of the transmitter, and has a soft rubber strip, H, extending across the outer or open end of it, and a rod or vibrator, I, passes through the rubber strip, H, and rests at its inner end, in a puncture in the disc, E, and is formed at its outer end with a button or presser, I^1. To use this apparatus for the purpose for which it is intended, the speaker holds the tubular extension, G, in such a position that the button, I^1, of the vibrator will be pressed lightly against the exterior of his throat, near the larynx or vocal organs, and the person to whom a message is to be transmitted holds the receiver to his ear in the usual manner.

16417. "Improvements in electric generators and motors." H. CUSHMAN. Dated December 13. 6d. Relates mainly to a novel construction of armature ensuring great simplicity and economy in manufacture and allowing of the easy renewal of parts liable to deterioration. Also relates to the combination of an improved armature, with one or more pairs of magnets so wound and arranged as to constitute a single magnetic circuit, or circuits, extending across the machine between the said pair or pairs of field magnets in such a manner that the said armature may be rotated in a plane at right angles to a line drawn through the centre of the induced portion of the magnetic circuit, or in a plane substantially parallel to that in which the exciting current flows in the convolutions of the wire around the magnets, and that the radial portions of the conductor shall successively cut through the lines of force at right angles thereto.

CORRESPONDENCE.

Prof. Galileo Ferraris on Secondary Generators.

I should be obliged by your inserting the enclosed letter to Prof. Ferraris in the ELECTRICAL REVIEW:—

"Owing to my ignorance of Italian I have been unable to read the copy of your paper on the secondary generators of Gaulard and Gibbs which I received some weeks ago, but an abstracted translation of your paper, which is appearing in our journals, has made me aware that you have quite misunderstood what method of experiment I adopted in determining the coefficient of efficiency of these instruments. That you should have thus misunderstood me is not altogether surprising, for I did not attempt to explain my method of experiment, as the purpose of my report was merely to inform the company which consulted me what the capability of their instruments really was. I did not, as I gather that you assume, determine the mean difference of potential between two points of the circuit and the mean current in the circuit and multiply these two together to obtain the work done, for I have for some years—in fact, since I first studied the theory of alternating currents—known that such a method would be erroneous. What I actually did was, by a single observation of the electrometer, to determine the mean value of the product at each instant of the current and the difference of potential. This is done by a very ingenious modification of the method of M. Joubert, proposed by Messrs. Ayrton and Perry some years ago. The method is as follows:—Let A, B, C, be three points of a conductor in which an alternating current is passing, let the resistance between A and B be r, and let there be no self-induction or electrostatic capacity between A and B; it is desired to determine the work done by the current. Connect A and B to the two quadrants of the electrometer, C to the needle, then if the quadrant electrometer be in perfect adjustment, the force tending to deflect the needle will be proportional to

$$(A - B)\left(C - \frac{A + B}{2}\right)$$

A, B, and C, being the potentials at the corresponding points. Now $C - \frac{A + B}{2}$ is the difference of potential between C and a point D midway between A and B, and $\frac{A - B}{r}$ is the current passing in the conductor, hence the force tending to deflect the needle at any instant is proportional to the work being done at that instant between the points D and C. Hence it follows that the deflection of the needle multiplied by the resistance, r, is a correct measure of the work done in unit time between D and C.

"After this explanation I think you will agree with me that the method I adopted was correct, and that I

have not made the error you not unnaturally supposed I had made. Owing to the considerations which you point out, the efficiencies M. Uzel deduces from his experiments are all somewhat lower than those experiments really indicate. My own conclusions, viz., an efficiency of 79·3 per cent. for the old type of instrument and 86·1 per cent. for the new type, are the correct deductions from the observations which I made. My use of the electro-dynamometer in the case in which I used it for verification was also strictly correct for the self-induction of the portion of the circuit in which I proposed to measure the work done was practically nil. I send herewith a copy of my lecture before the Institution of Civil Engineers, and would ask you to refer to the remarks on page 11, also a copy of a recent paper of mine on alternate currents, in which the subject of secondary generators is touched upon; from these I think you will see that I was hardly likely to make the fundamental error which you have attributed to me.

"I am sending copies of this letter to the English journals in which abstracts of your paper have appeared."

J. Hopkinson.

4, Westminster Chambers, Victoria Street, S.W., *April 22nd*, 1885.

Du Moncel on Bourseul's Magneto Telephone.

In the REVIEW of December 8th, 1883, I named Charles Bourseul, a soldier in the French army in Africa, as the first inventor of the Speaking Telephone, and I gave a description of Bourseul's instrument translated from a newspaper, *L'Illustration*, published in Paris on 30th July, 1854. In support of my statement that the description of Bourseul's telephone furnished all the information necessary to make a magneto telephone, I cite the following extracts from a paper signed by Comte du Moncel, published in *La Lumière Electrique*, on 29th December, 1883, as follows :—

"*M. Bourseul avait donné une description très détaillée de sur système dans le Journal l'Illustration du 30th Juillet*, 1854, *description qui ne laissart aucun doute sur les moyens qu'il mettâit à contribution.*"

It has been repeatedly urged that if such a wonderful discovery had been made public, it certainly would have been put into practice; but the fact that scientific men of that day did not appreciate nor understand the full scope of the wonderful invention is not evidence that the invention had not been made. Did not Comte du Moncel, in his *Exposé*, in 1857, treat the invention as "a fantastic idea of a certain M. Ch. Bourseul?"

In reply to all such cavilling, I quote the following words from the judgment of the Master of the Rolls, the late Sir George Jessel :—

"Though nobody knows how to make a receiving instrument, if we are told this is a telephone receiver that will give articulate sound, it would nevertheless be a publication, though nobody knew how to work it." And Lord Justice Burns, in his judgment in the same case, said: "I can conceive an instrument being useless at the time when its use was not known, but which afterwards became useful.

W. C. Barney.

April 19th, 1885.

A Proposed System of Stretching Overhead Wires.

During the present diversity of opinion on the advisability of overhead *versus* underground wires, I should like to place before your practical readers, for their consideration, an idea of a system of stretching such overhead wires.

In the first place, in the consideration of aerial or subterranean wires it is, I think, well understood that cables for the transmission of currents for light, or power, must of necessity be placed underground. Such being the case then in the future of electricity, when the cables are laid in considerable numbers and carrying strong currents, might there not be some fear of induced currents sufficient to interfere with the working of telegraphic, and more especially telephonic, communication, if such wire were laid side by side?

I put the question for the consideration of those who are more practically conversant with electricity than I am myself. Again, I suppose there is the question of expense in favour of the overhead system.

For various reasons, it appears to me that aerial wires are best suited to telegraphic and telephone work, providing they can be fixed so as to be free from dangerous results.

The question is, then, how to put these wires up satisfactorily, and in such a way that they shall do little or no damage in the event of their breaking.

Suppose, then, that they be stretched *only* along the route of roads as railways, canals, and streets, and in the case of streets, *only* along the tops of houses, and not within, say, 8 or 10 feet of the roof.

Also, whenever they have to cross a street (if it be railway, canal, or housetop line), it must cross *only* at right angles to such street, and at a height (from the ground) of *not less* than once-and-a-half the width of the street it crosses; also the points of suspension to be as near the width of the street as possible.

Now, if such a portion of line should break midway between the points of suspension, neither end would reach the street, and even should it break *at* either point of suspension the loose end of wire would not reach to within 7 or 8 feet of the ground, and would, therefore, not be in the way of traffic or even pedestrians.

And should any other portions of the line break down, it would simply fall on to the housetop over which it was suspended.

Of course, no wire would be allowed to be stretched diagonally.

The fixing of poles, &c., would be arranged as it is now, but with such restrictions as not to allow anyone so much power as the United Telephone Company appear to have.

John Whitaker.

Manchester.

P.S.—This idea may be old, it may not be practical, it may not in fact be worth a second consideration, if so, I pray readers will excuse my ignorance.

Accumulators.

In reference to the above and to the important fact that the successful future of electric lighting depends on the perfection of the so called storage battery, it is satisfactory to know that progress is being made in this direction. Mr. Preece in his Report on electric lighting in the City, said were these batteries to prove successful nearly all the difficulties in electric lighting would vanish, a wire the size of a lead pencil would replace the massive conductors required by the parallel system, and electric lighting would become a financial success. This being the case, it is with pleasure we read the important statement made by Mr. Bernard Drake in your last issue, viz., that the difficulties as to buckling and the consequent falling out of the active material from the plates have been completely mastered, also the life of the same has been more than doubled. This statement, which I have every reason to believe, is gratifying and cannot be too widely known, as many of us are unfortunately possessed of the knowledge that the failures in the early cells were to a great extent due to the above causes. I do not think it can be denied that for safety and perfection in incandescent lighting where in a large or public installation the demand would be so very uncertain, it is impossible to get at all times perfect results without accumulators. So called regulators are wasteful in the extreme; a good accumulator is the best regulator. I have seen it remarked that accumulators are beyond human comprehension; also secondary batteries are very costly. The simple actions of the decomposition and recompositions of water is not very incomprehensible; as to cost, how many metals and their oxides

can we obtain cheaper than lead? it is found in practice that lead couplings connectors, &c., are preferable, thus reducing the cost by dispensing with copper or brass. Experience of the last few years teaches me to believe there is no very great difficulty in the way of producing accumulators with an average life of six or seven years and a useful capacity of 500 ampères per cubic foot. Those who have not used accumulators cannot appreciate them; those who used the embryo cells cannot judge the present one. It is generally admitted by those who have used a good set of cells that their advantages are many. It only remains for the vendors of this necessary adjunct to reduce their rates which at the present time appear to be too high a R for the E.M.F. of the C opinion.

Pb O_2.

A Model Telephone Exchange System.

Under the above heading I see in your issue of 18th inst. an interesting article; but I consider that before it could be received in this country as such it would have to be very much remodelled and improved. So much so, indeed, that I consider from the description that the exchange in Brooklyn is far behind our best exchange systems.

I see that a dial connecting each operator with all the others in the exchange is used, and consequently comparative quietness prevails; but in the best exchange systems now there is no need for any communication from one to the other, as every operator has the control of every wire in the exchange, without applying or communicating in any way to any other operator.

The only point new or worthy of notice in dealing with leading-in wires, is that lightning arresters are not used, a departure from the advice of almost all experienced electricians and engineers; and any day the fusing of a number of the coils of wire inside (if nothing more serious) may effect a speedy conversion to the almost universal opinion on the subject.

It is noticeable that there are good arrangements for dealing with faults, or "misconnections," as they are called; but from the fact that there were 333 such in one day, it surely is time that the *cause* of such a great number was taken up and dealt with, as something very serious must be wrong to cause so many "misconnections." The writer has experience of an exchange from which about 1,000 wires are controlled, and there is not on an average day one-tenth that number of faults from every cause; and yet the subscribers use their telephones much oftener than the subscribers of this model exchange system do.

The form showing the report of connections is also far behind. It should show at a glance all it does, and in addition the average calls for each subscriber day and night separately, the average cost of operating each subscriber, and the cost of each call.

Had not the model system of Brooklyn been given out with the profession of helping "other exchange managers to obtain information that will be of use to them in directing, enlarging, or lessening the cost of their business," it might not seem fair to criticise it in the above strain; but as it is, I think it only right that your readers should know that the model here held up to view is not one at all likely to take precedence of what we are using.

Denshin.

Symbols for Electric Lamps.

While thanking you for inserting my letter on the above subject, I ought to say that it was in a practical sense that I thought such symbols would be useful: for instance, in the sketches of connections which every electrical engineer has to make; also in printed accounts of apparatus and systems.

We have several symbols already—for example, the well known galvanometer, resistance, and condenser symbols. My plan is to add to these in order to meet the wants of the time, and make the set fairly complete. Only a few more would really be required for practical purposes so as to include the new apparatus (of electric lighting, &c.).

At present there is no real uniformity; and, while the different figures employed by individual engineers show that such symbols are wanted, they do not serve the purpose, because there is no uniformity, and each symbol has to be described by reference letters, or the name itself attached, instead of being intelligible at a glance. Moreover, there are not enough of them.

The symbols should be simplified pictures rather than arbitrary figures, and of an elementary but distinctive character, easily drawn on paper, and set up in type. The advantage of an International committee sanctioning these is that their general adoption would be better ensured. If engineers would agree amongst themselves to adopt the same symbols, the action of such a committee would be unnecessary.

Instead of introducing complication, my proposal is in the direction of greater simplicity and convenience.

J. Munro.

Barnett's Secondary Batteries.

With reference to the query which appeared in your journal of last Saturday week, for information as to the manufacturers of my secondary batteries, I beg to inform you that Messrs. Spagnoletti and Crookes, of Adelaide Works, Shepherd's Bush, have been appointed by me sole manufacturers of this battery.

They have completed, and have now just got into regular work, the new buildings and machinery necessary for their manufacture. They would be happy at any time to show the works and batteries to anyone who might care to see them.

Harry T. Barnett.

London, *April 22nd*, 1885.

Ruddle's "Cut-Out."

I have on several occasions found the branch cut-out illustrated by you in your issue of the 11th inst. extremely useful.

But the design is not at all new, as a plug of this description forms part of the system of the Sawyer-Mann Company, of America, and was shown by them in their advertisement in the *Electrical World* some twelve months back. The only difference being that they solder their lead wire to the ends of the brass strips, instead of using small terminals. Perhaps Mr. Ruddle does not know this. I enclose my card, and remain

Z.

Manchester, *April 20th*, 1885.

Induction and Conduction.

As Mr. Willoughby Smith has not responded to my suggestion in your issue of March 28th, I am forced to the conclusion that he cannot bear out his assertion that "at the present day theories are propounded which, although marked by the sincerity of the propounder, will not bear even the dullest light of criticism." The recent letters of Mr. James Johnstone, which the above remark called forth, are significant of the embarrassment which these flippant statements cause to those who have, with good intentions, done their best for the advancement of electrical science; and in common fairness, or even honesty, it would seem to be more consistent with the sincerity which Mr. Smith admires if he were to put the matter at rest by being more definite.

In my last letter I drew attention to the fact of Mr. Willoughby Smith having ignored or overlooked the action of secondary currents in his experiment. These currents may be made evident in the same manner as those obtained from a magnet, and there is every reason to believe that they not only exist in the reversibility of polarity of the smallest magnet, but also in the

variation of tension and discharge of the Leyden jar, and—if it could be proved—even in the flash of lightning itself. In short, in all and every kind of electric or magnetic change of state—another reason for identifying all the electricities as one kind of energy. It would also seem that the difference between secondary currents obtained by various ways is simply one of degree as regards their time of duration and E.M.F., whilst their quantities are proportional to the initial or exciting currents.

With your permission I will reproduce Mr. Smith's drawing. It is shown at fig. 1 with the addition of a secondary circuit. This latter is a closed metallic circuit, and is coiled with, but insulated from, the primary coil, B. By carefully taking the sum of the deflections of the two galvanometers on charging and discharging, Mr. Willoughby Smith will find his quantitative results considerably modified.

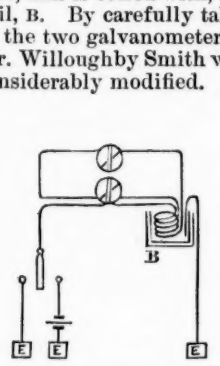


FIG. 1.

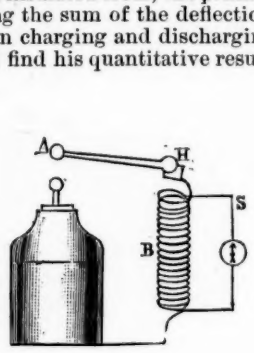


FIG. 2.

Fig. 2 shows a Leyden jar ready for discharging. The wire, B, is coiled, and is in communication with the outer coating of tinfoil. The arm, A, is hinged at H—the ordinary slide would do equally well—to regulate and vary the distance between the two knobs, thereby increasing or diminishing the stress in the coil, B, without having any actual discharge, unless desired. The secondary circuit, S, is coiled in close proximity to the coil, B, but having no electrical communication with it, except by induction. It is almost unnecessary to say that this experiment is designed to show that the discharge, or any increased or diminished tendency to the discharge of a Leyden jar, inevitably causes secondary currents either in the conductor itself or in a neighbouring conductor.

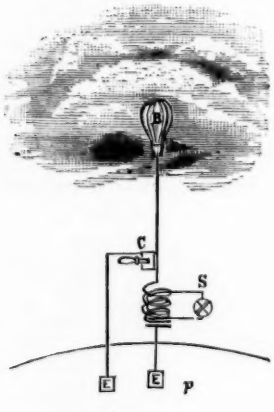


FIG. 3.

Fig. 3 is a diagram of an experiment that I should very much like to try. Perhaps some one of your numerous readers may be in a position to do so when a suitable opportunity occurs. N is supposed to represent clouds negatively charged by atmospheric electricity, whilst the earth, P, is positively charged. B is a balloon held captive by a copper wire. This wire is coiled near the earth, and terminates in a copper plate. Another copper plate, whose plane is parallel with that of the first plate, leads to earth; the two plates being separated by a dielectric. The secondary wire, S, is coiled by the side of the primary coil, and has a galvanometer in its circuit, as shown. C is a circuit-changer, whose object is to periodically break the continuity of conductivity from the balloon, and discharge the primary coil by placing the latter in circuit with the two earth plates. With a delicate galvanometer, and all things being favourable, by manipulating the circuit breaker I should expect a deflection of the galvanometer when the primary coil was being charged, and a deflection in the opposite direction when it was discharged, thus proving the existence of secondary currents in this form also.

E. L. Voice.

49, George Street, N.W.,
April 20th, 1885.

Re-winding Dynamos.

It is unfortunate that Mr. Esson did not consult my first paper on the above subject before venturing to attack this question, as he would then have been more in a position to write upon this matter.

The figures in example (2) are not in accordance with my formulæ, neither do the figures in example (3) agree with Captain Cardew's formulæ; so that if Mr. Esson's figures were correct there would be not two but four solutions to this question. But to produce the work given in example (2) it is necessary that the resistances of the armature and field magnet should be $\cdot 085\omega$ and 15ω, and not $\cdot 087$ and $20\cdot 4$, as given by Mr. Esson. The resistance given by Mr. Esson to the field magnet in example (3) is too great to excite the field magnet properly, and would simply upset and reduce both external and internal work.

I should ask Mr. Esson by what kind of formula he was enabled to arrive at the figures he gives if he did not by his remarks betray an absence of a knowledge of algebra.

Perhaps I can best convince Mr. Esson of the absurdity of his views by explaining how his statement that "*the internal work in any dynamo depends upon the sum of two quantities without reference to their individual values*" is wrong, and how these two quantities are interdependent.

It is required to change a field magnet from direct circuit to a shunt circuit while maintaining the external work, the internal work, and the velocity the same. The first essential is to maintain the potential at the terminal of the machine the same, in order that the work in the external circuit may be the same. To do this, it is necessary both the current through the field magnet and the electromotive force of the machine. But these two quantities are interdependent, and neither may be changed without the one varying as a function of the other. By making the magnetism (and therefore the work) in the field magnet in shunt circuit the same as when it is in series, and by changing the electromotive force by making the resistance of the armature lower, I have shown how in a simple manner the work in all parts of the system may be maintained the same. But if the external work is to be maintained the same without re-winding the armature, it is then necessary to have a weaker field magnet. But owing to the interdependence of the electromotive force and the current through the field magnet, before it is possible to discover the precise value of R_1 that will maintain the external work the same, it (firstly) is requisite that a formula that will fit the characteristic curve of magnetism of the field magnet should be known, and then the application of Laplace's theorem is required, unless the method of "trial and error" is then used to determine R_1. But after having discovered a value of R_1 which will maintain the work in the external circuit the same without re-winding the armature, it will be invariably found that the internal work is somewhat greater than if the armature had been re-wound.

W. Moon.

18*th April*, 1885.

WOODHOUSE & RAWSON,

ELECTRIC LIGHT ENGINEERS, MANUFACTURERS, AND CONTRACTORS,

SUPPLIERS TO THE TRADE OF ALL ELECTRICAL APPLIANCES.

OFFICES—11, QUEEN VICTORIA STREET, LONDON, E.C.

Official Tests by Wimbledon Local Board:—

TIMES of *August 18th*.—"The lamps as finally adopted were the Woodhouse & Rawson Glow Lamps of 50 candle-power each, and these were variously arranged for the purpose of comparison as to the best method of suspension and light distribution. Some of them were placed singly and also in small clusters on poles 20 feet high, while others were suspended singly from cantilevers over the pathways and at a less height. Others, again, were suspended at a height of 20 feet above the centre of the roadway, and 100 feet apart. A current of 2 amperes was supplied to each Lamp, which takes 22 volts and 2 ampères, which equals 104 watts, and gives an efficiency of 2 *watts per candle*. This, it will be seen, is a very high efficiency, that of the Swan Lamp being stated to be 3½ watts, and that of the Edison Lamp 4 watts per candle. It is noteworthy, too, that no breakage of the Lamps adopted occurred during the trials."

ALL LAMPS MARKED "WOODHOUSE & RAWSON."

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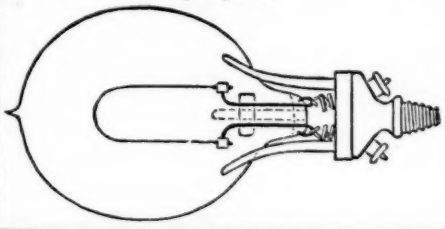

WORKS—CADBY HALL WORKS, HAMMERSMITH.

DAILY NEWS of *April 11th* on the Wimbledon Comparative Tests.—"The night before last some experiments were made with the Woodhouse & Rawson Lamps, which were regarded as very successful, and indicated an amount of efficiency that was astonishing. This enterprising firm have recently made great strides in the improvement of Incandescent Lamps."

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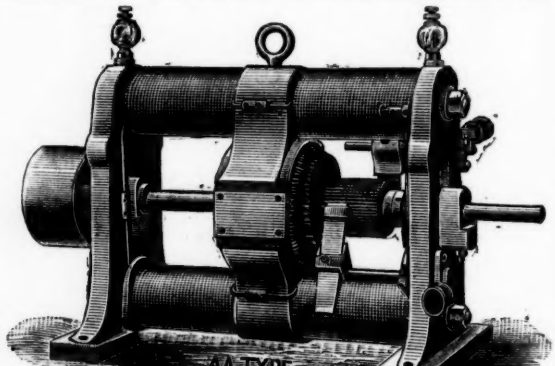

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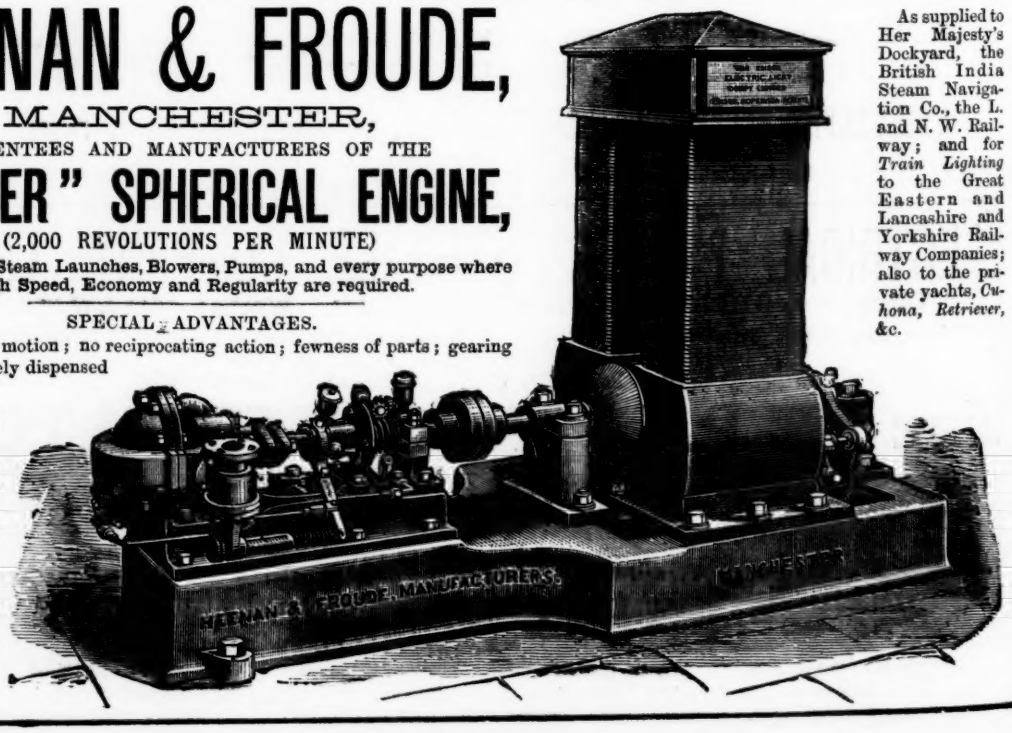

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